US009213304B2

(12) **United States Patent**
Shimizu et al.

(10) **Patent No.: US 9,213,304 B2**
(45) **Date of Patent: Dec. 15, 2015**

(54) **CARTRIDGE PROVIDED WITH COVER MEMBER INCLUDING A PLURALITY OF COVERS SEPARABLE FROM EACH OTHER**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/315,699**

(22) Filed: **Jun. 26, 2014**

(65) **Prior Publication Data**

US 2015/0003868 A1 Jan. 1, 2015

(30) **Foreign Application Priority Data**

Jun. 28, 2013 (JP) 2013-137421

(51) **Int. Cl.**
G03G 15/08 (2006.01)
G03G 21/16 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 21/1647*** (2013.01); ***G03G 15/0896*** (2013.01); *G03G 21/1676* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/0896; G03G 21/1647; G03G 21/1676
USPC 399/107, 111, 119
See application file for complete search history.

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(57) **ABSTRACT**

A cartridge includes: a frame; an agitator; a coupling; a first transmission gear; a closing member; and a cover member. The frame has a first wall having a developer filling port, and a second wall spaced apart from the first wall. The agitator is supported to the first and second walls. The coupling is provided at the first wall and receives a drive force from an external drive source. The first transmission gear is provided at the first wall and transmits the drive force received by the coupling to the agitator. The closing member is provided at the first wall and closes the developer filling port. The cover member is provided at the first wall. The cover member includes: a first cover to cover the first transmission gear; and a second cover provided separately from the first cover and to cover the closing member.

18 Claims, 14 Drawing Sheets

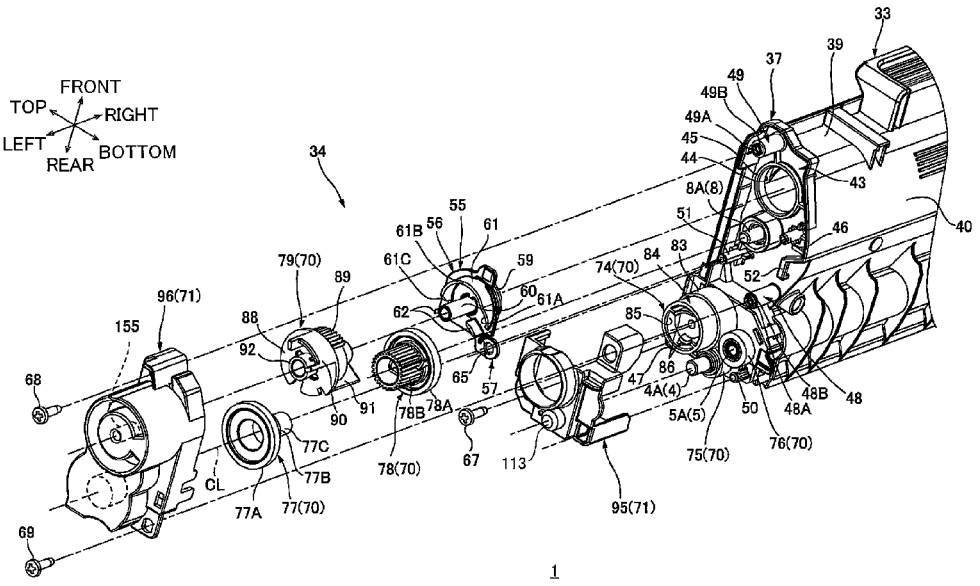
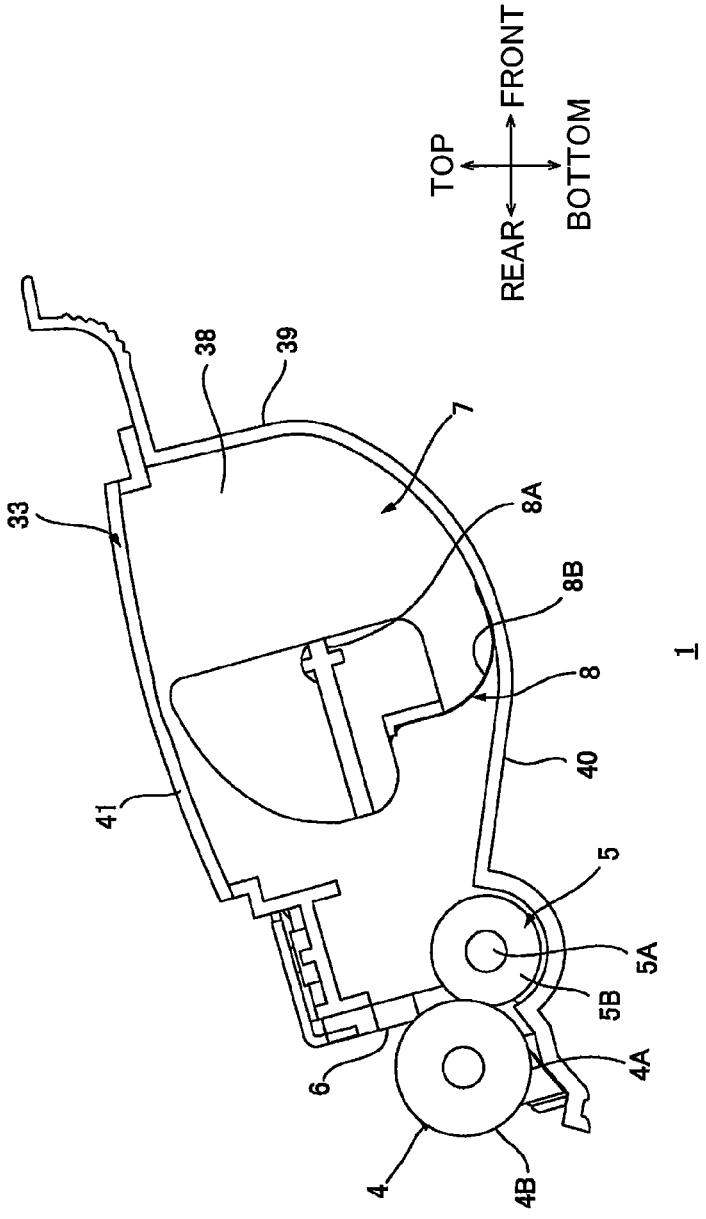


FIG.1



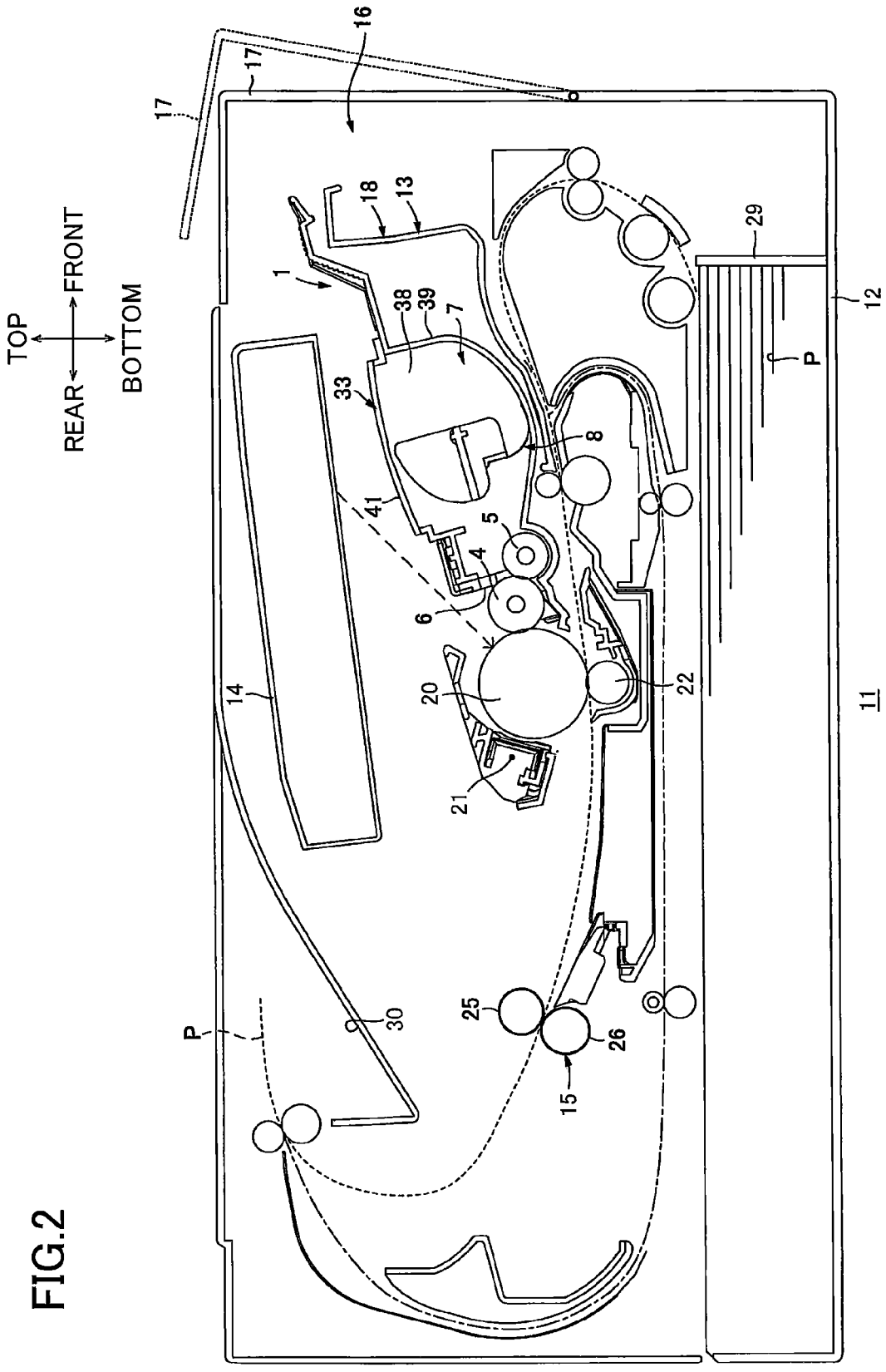

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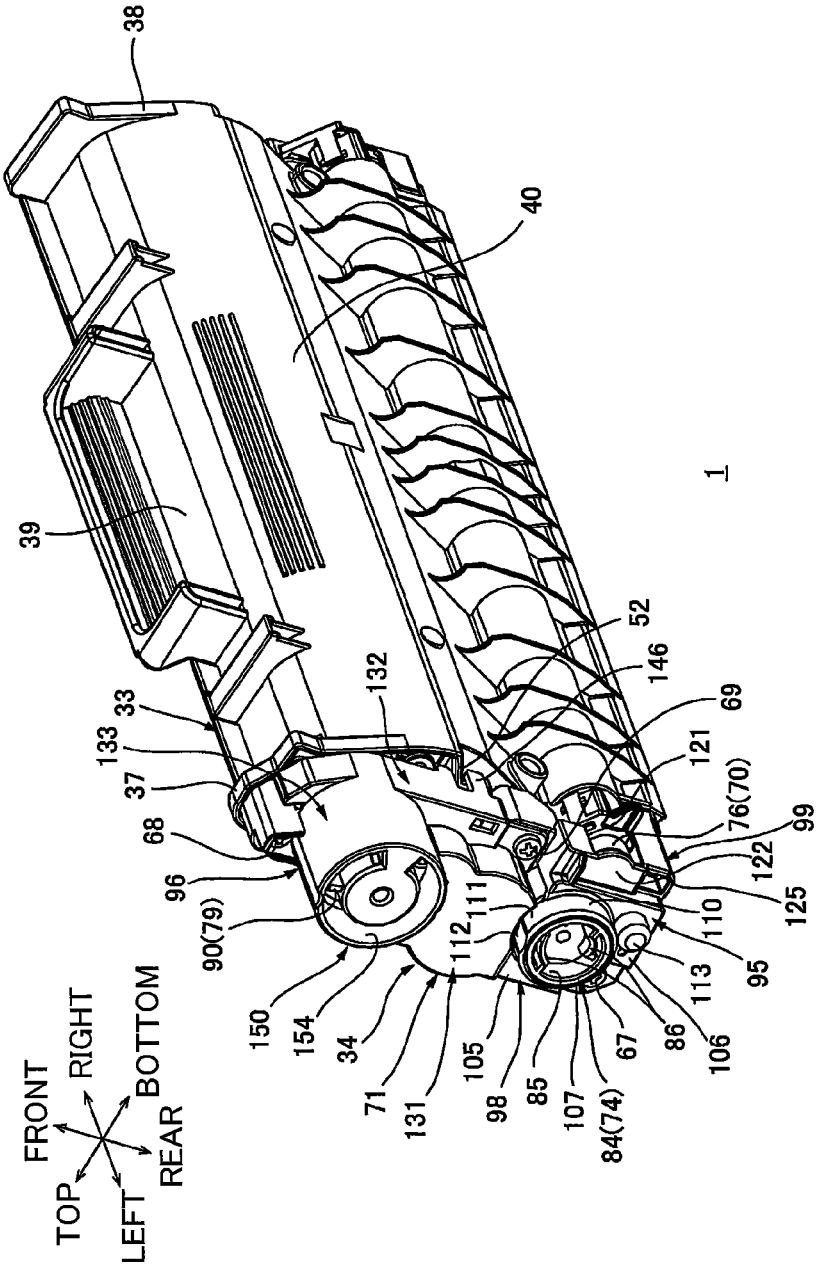
FIG.2

FIG.3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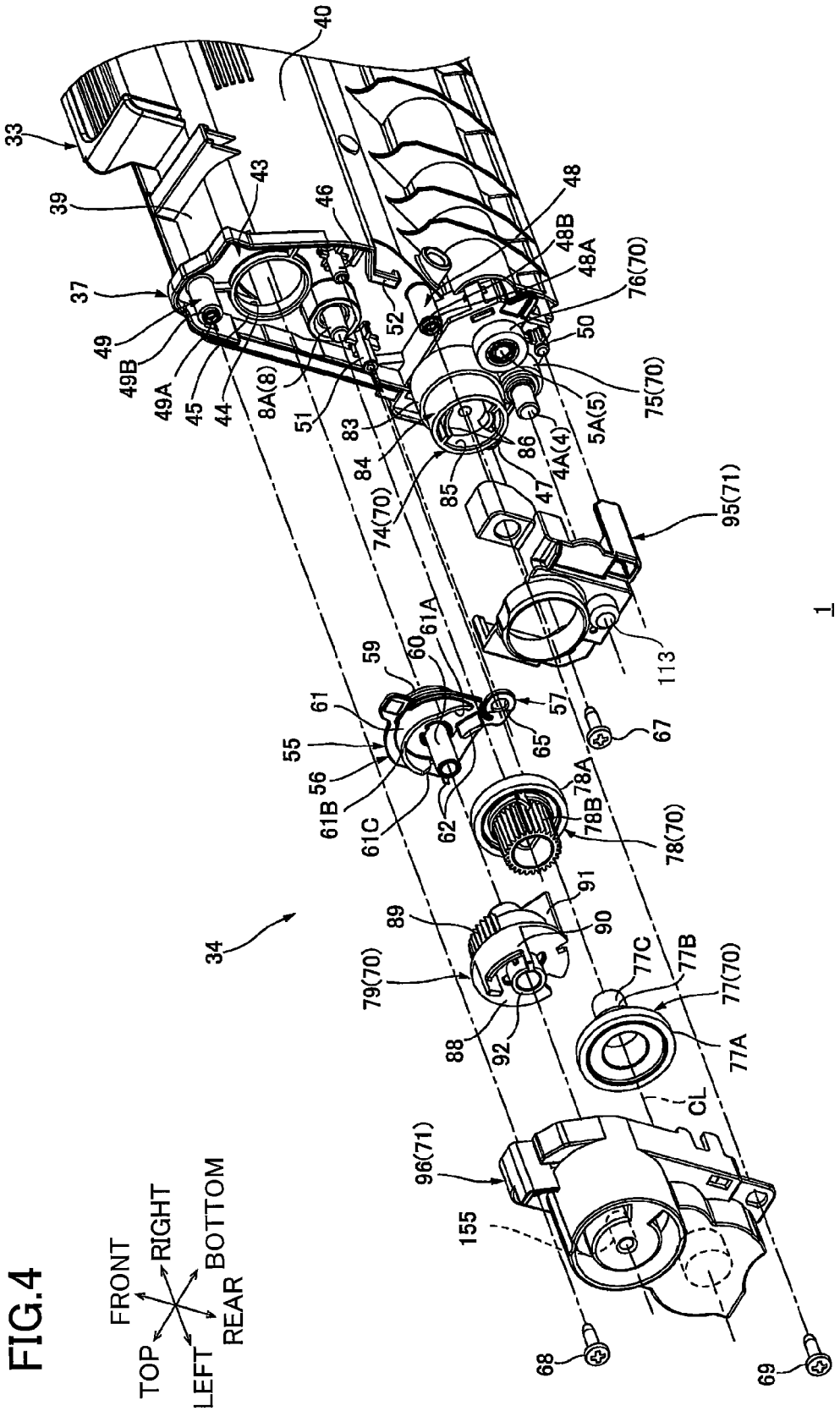
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79(70)
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FIG.4

FIG.5

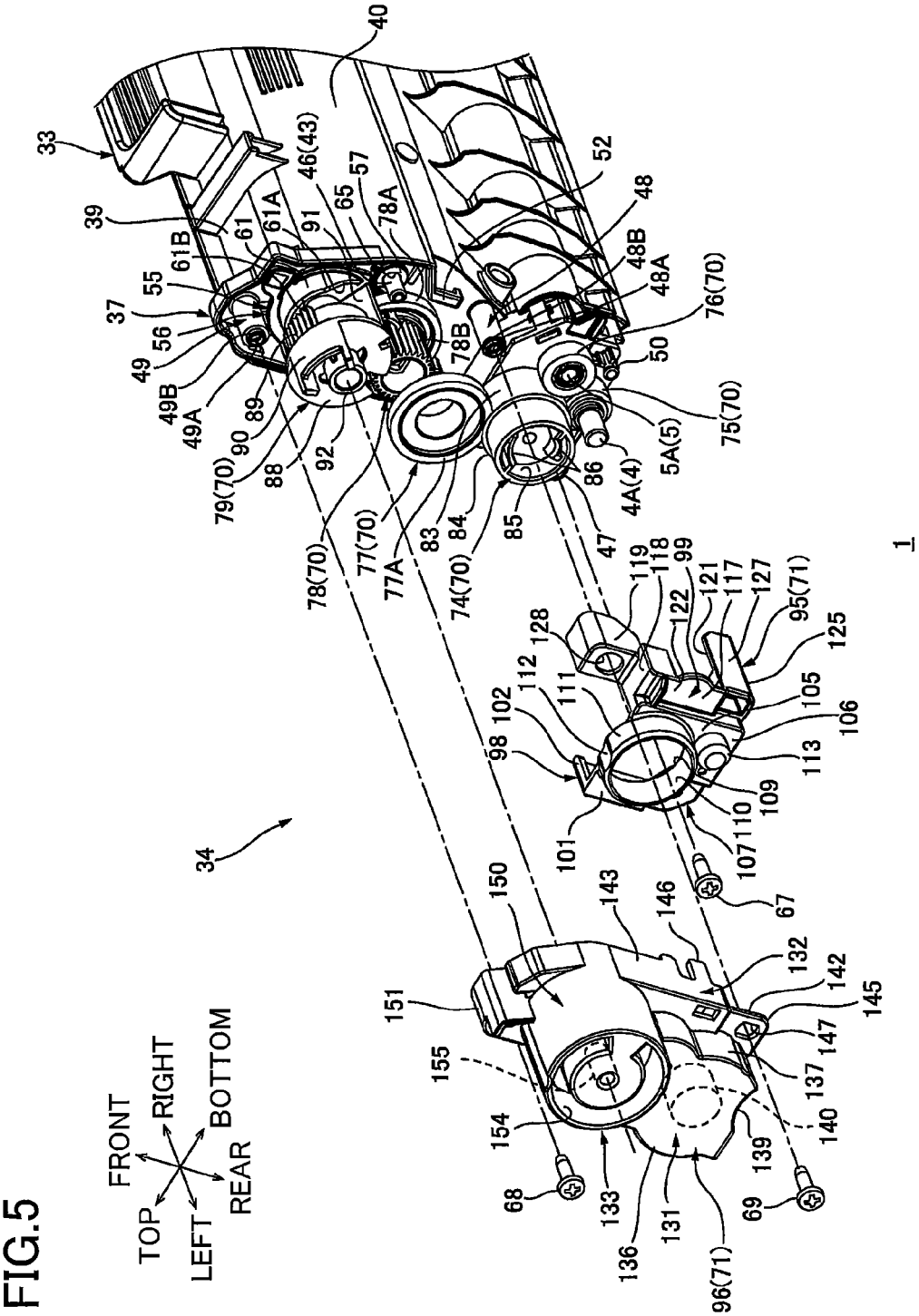
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FIG.6

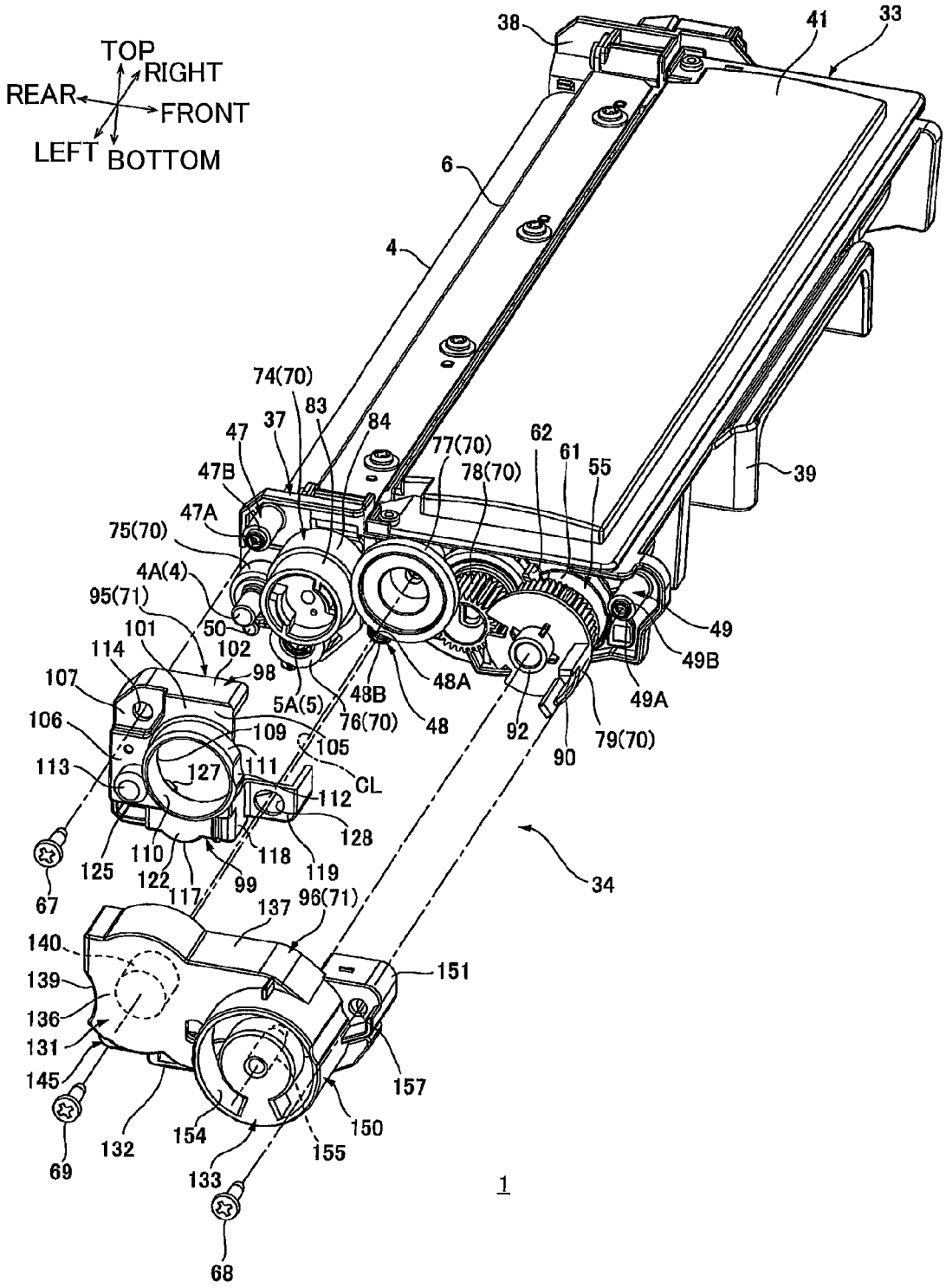
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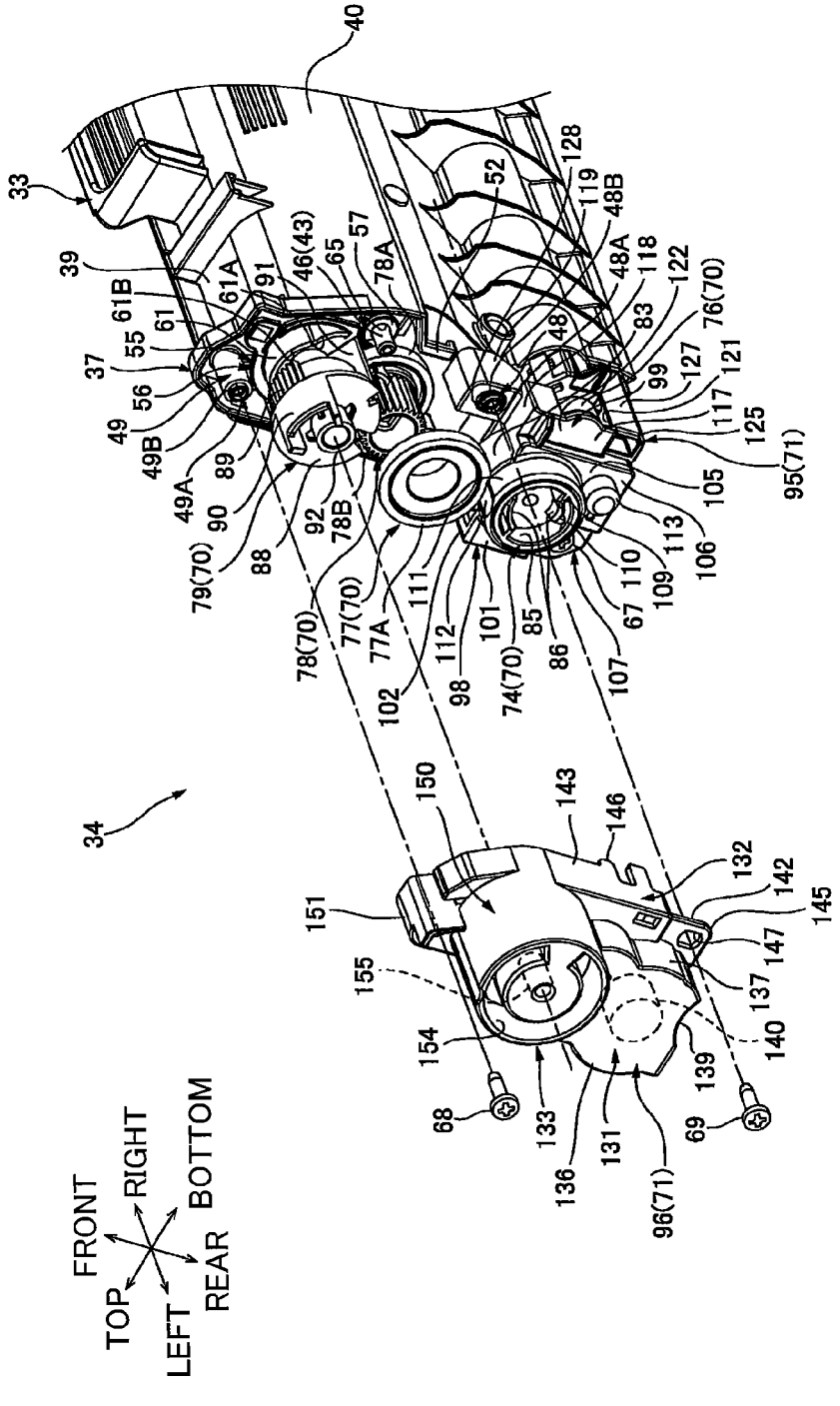
FIG.7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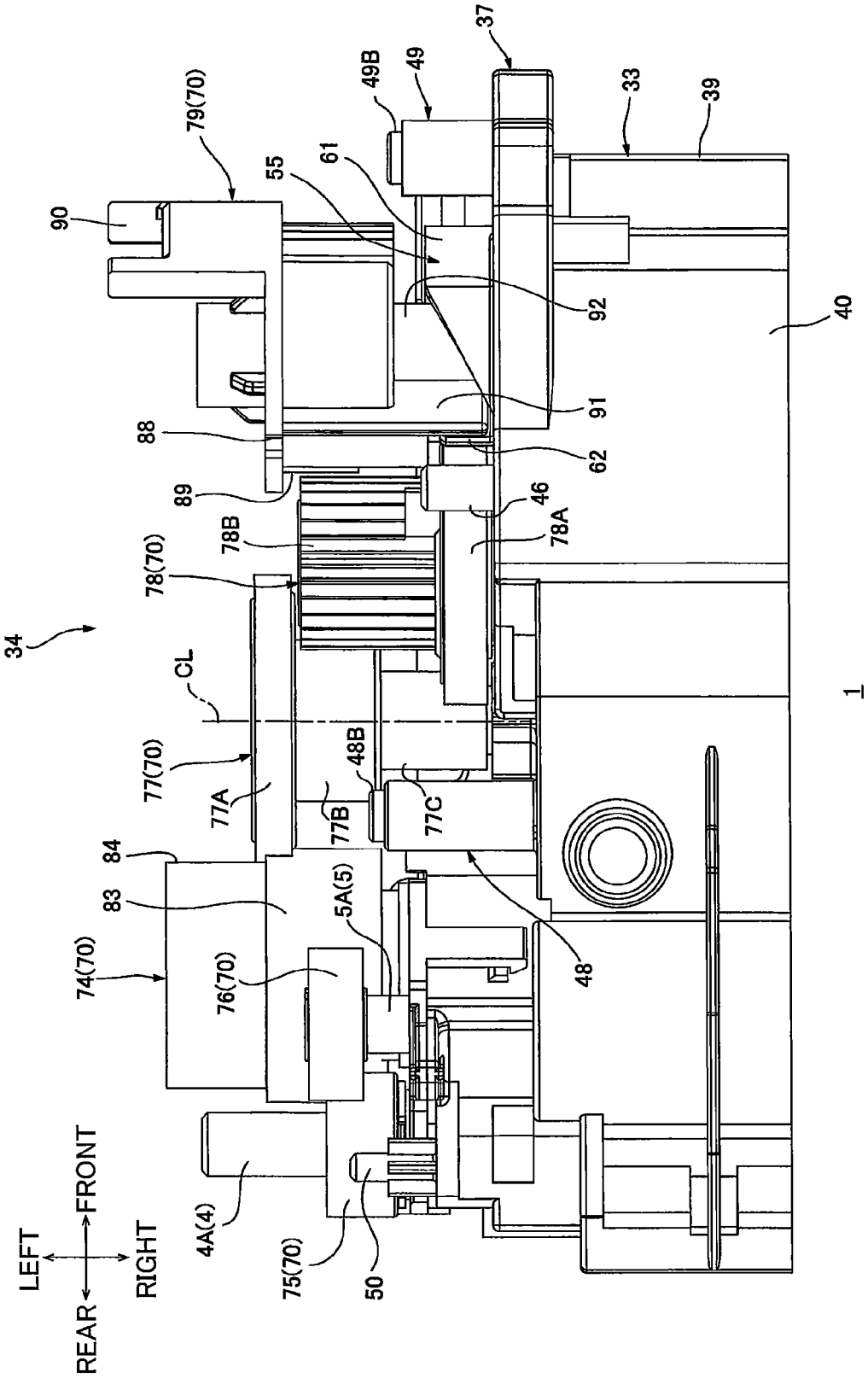
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FIG.8

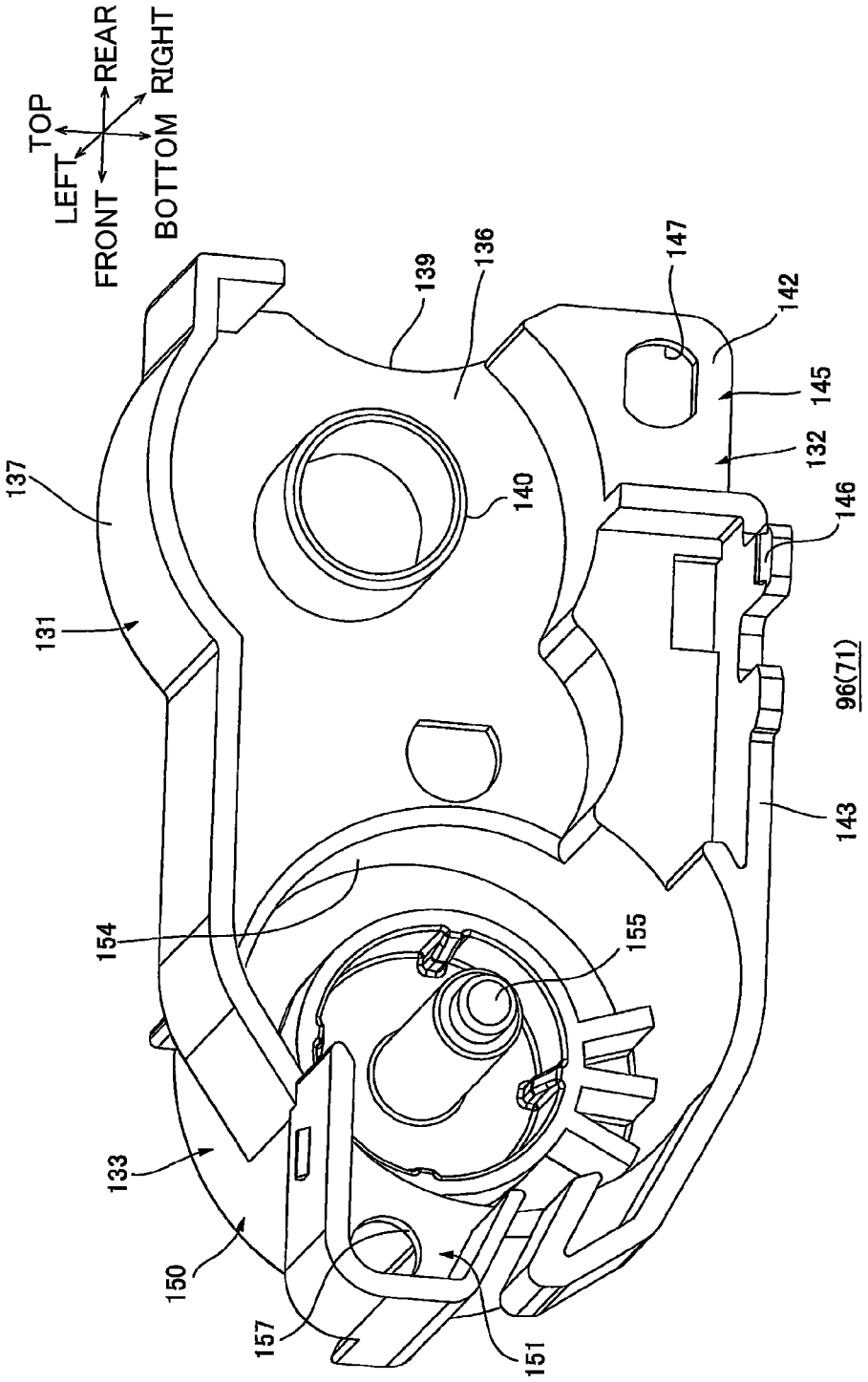
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FIG.9

FIG.10A

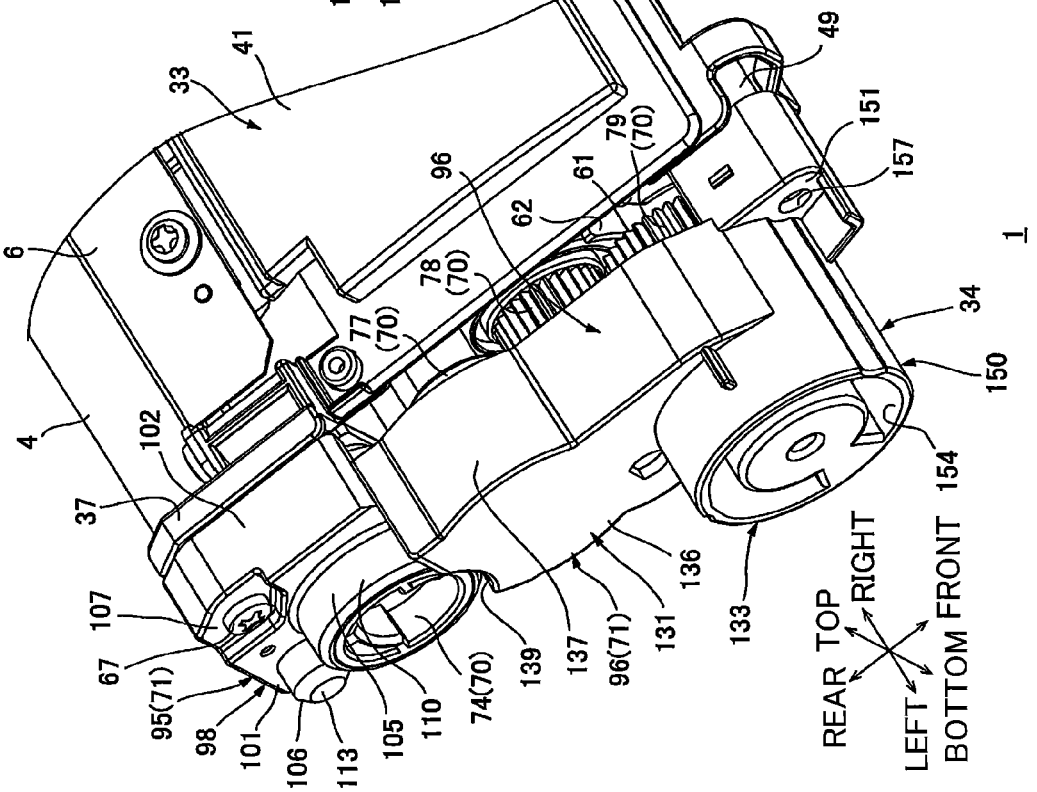
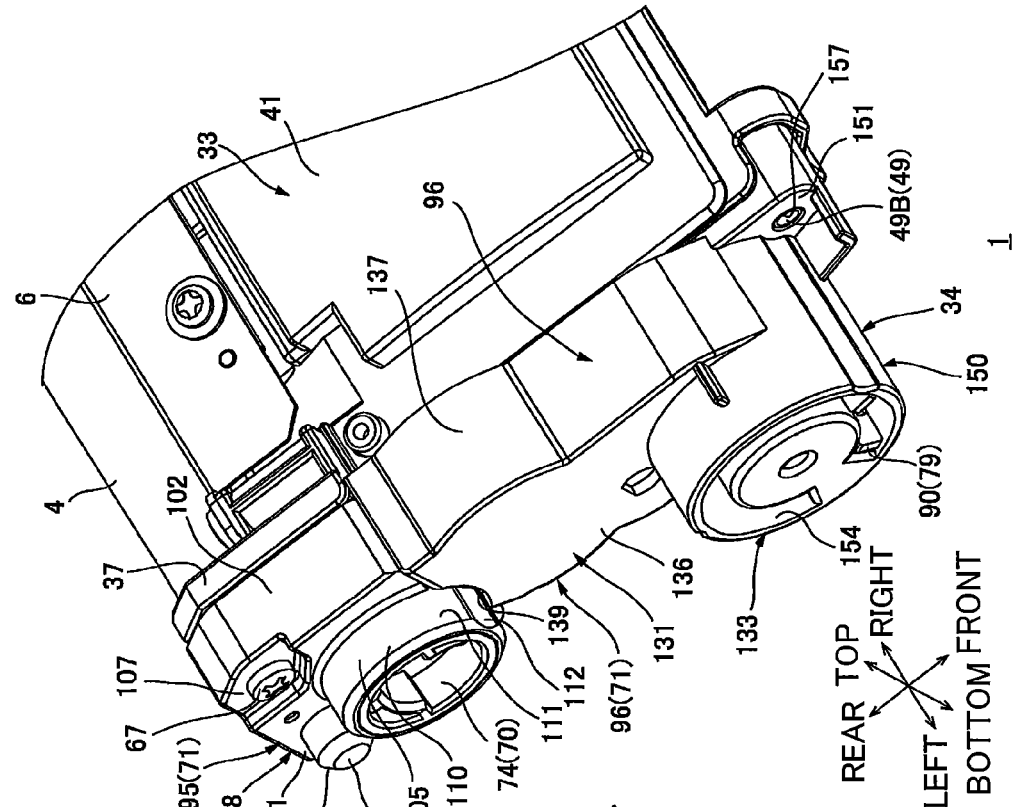


FIG.10B



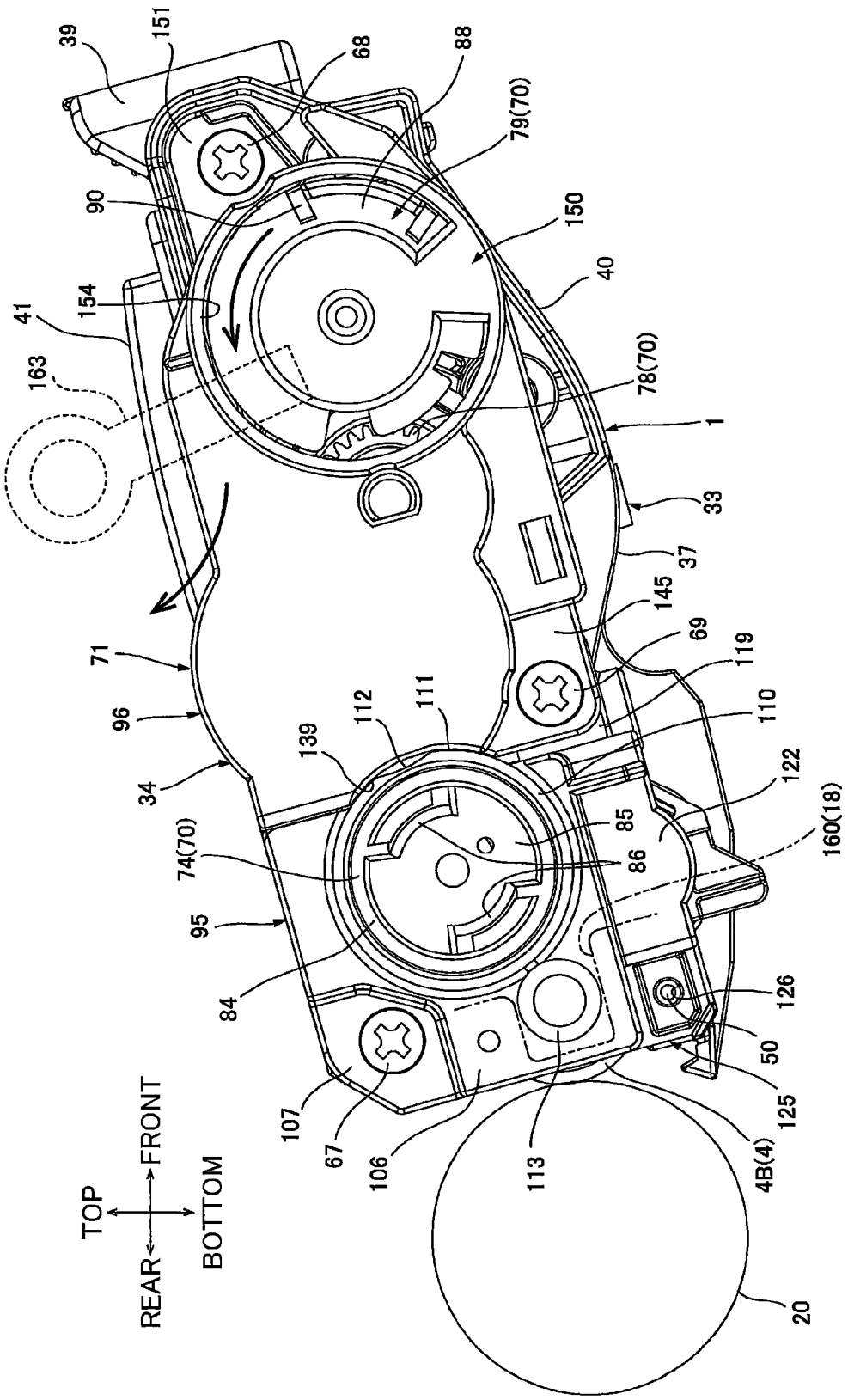

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FIG.11

FIG.12A

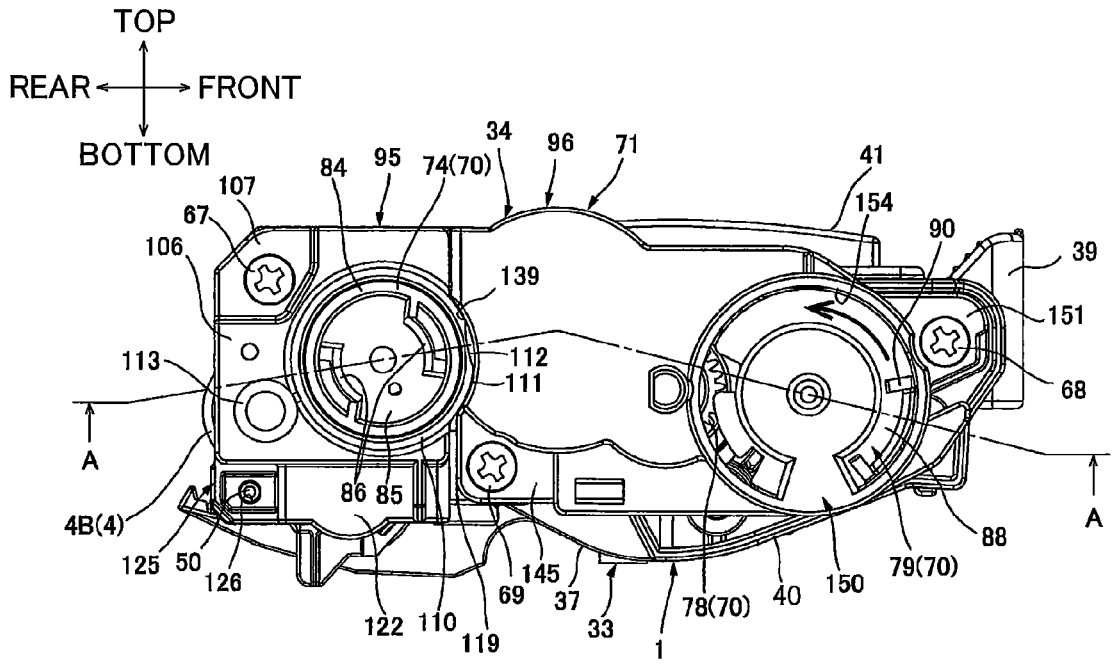


FIG.12B

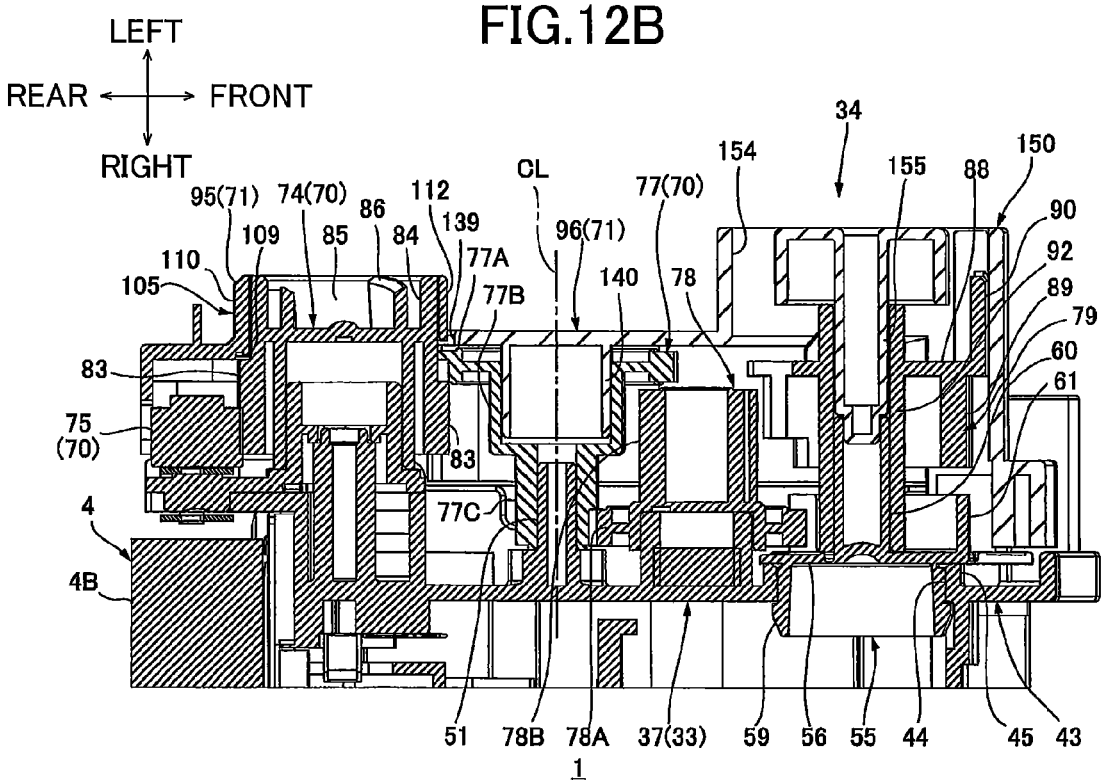


FIG.13A

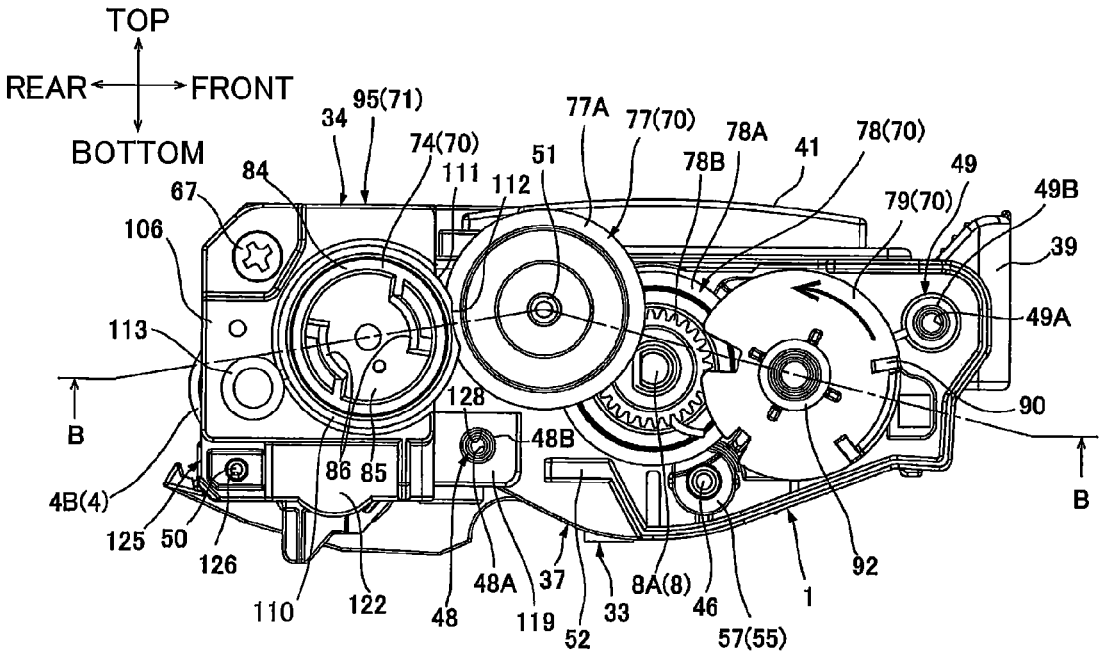
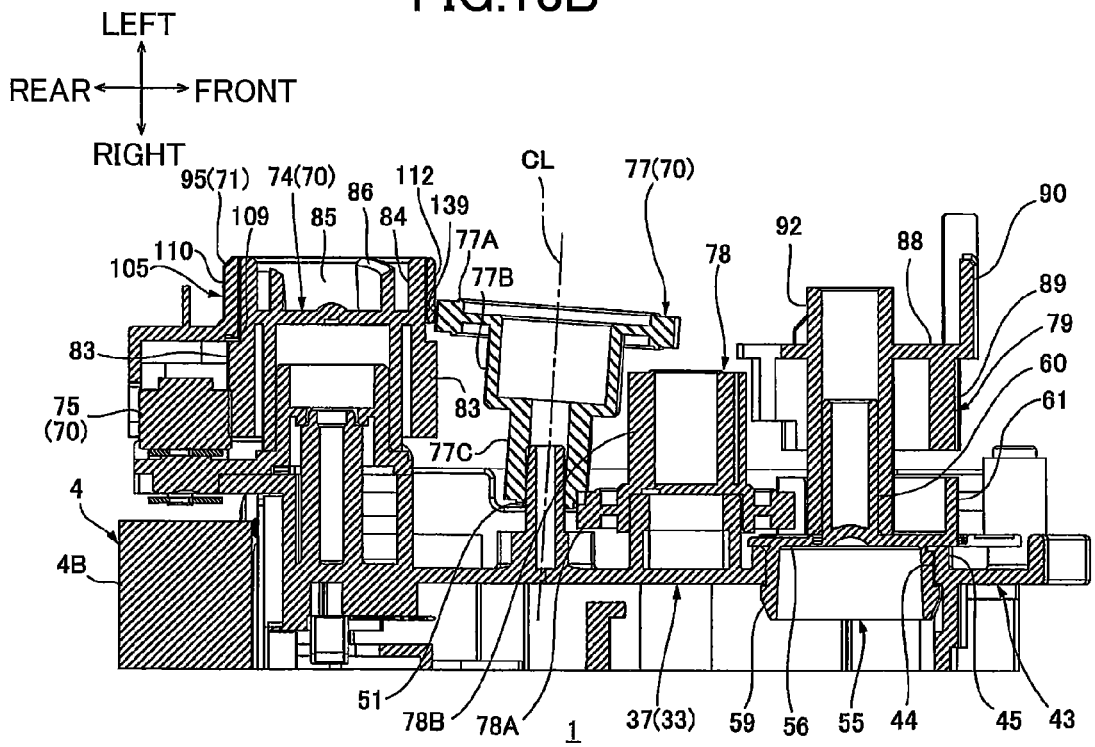


FIG.13B



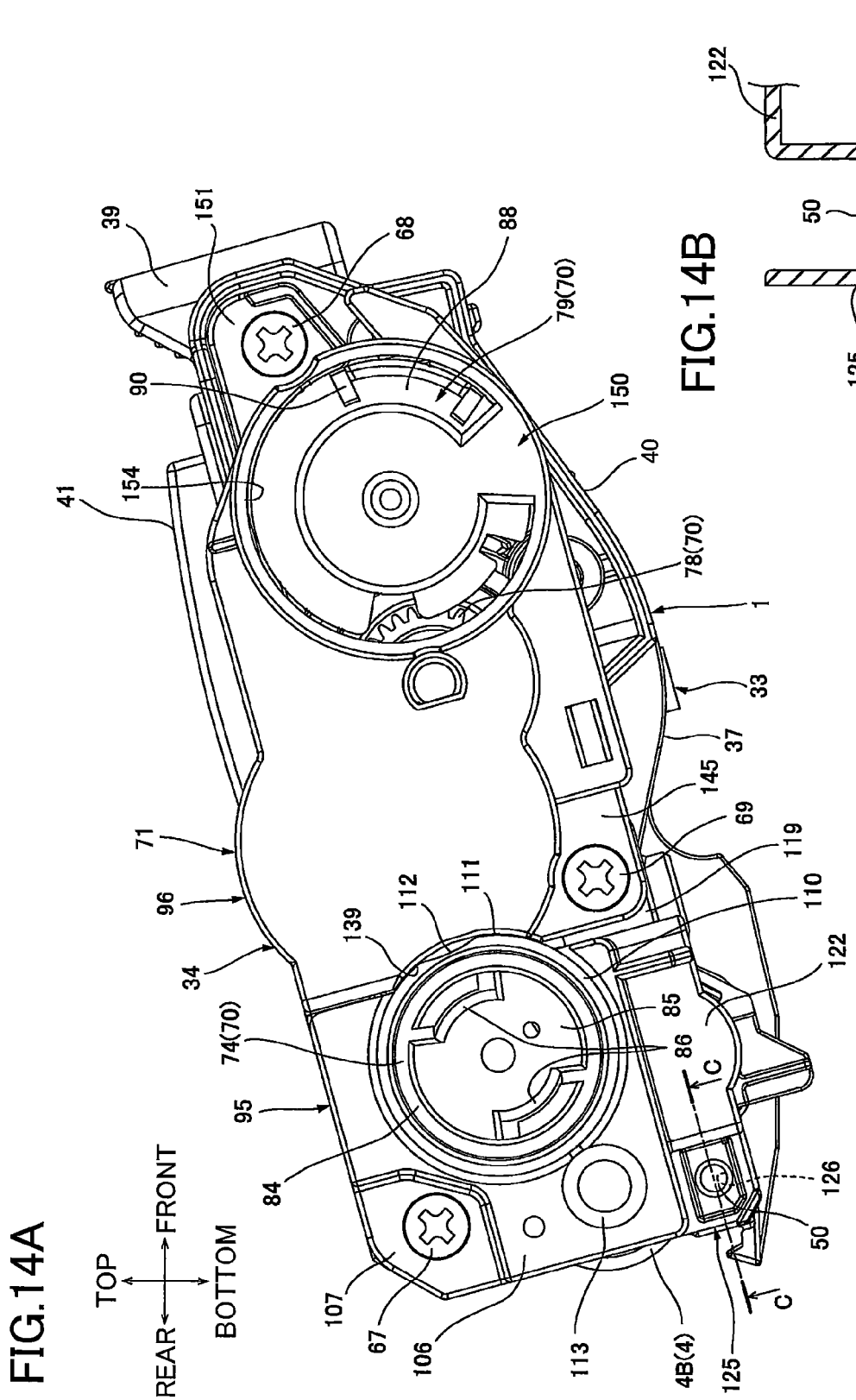


FIG.14A

FIG.14B

CARTRIDGE PROVIDED WITH COVER MEMBER INCLUDING A PLURALITY OF COVERS SEPARABLE FROM EACH OTHER

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority from Japanese Patent Application No. 2013-137421 filed Jun. 28, 2013. The entire content of the priority application is incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to a cartridge used in an electrophotographic image forming apparatus.

BACKGROUND

There is conventionally known, as an image forming apparatus, a printer in which a cartridge having a developing roller is detachably mountable.

As such a printer, there is proposed a printer including a developing device provided with a gear train for a drive system, and a side cover for protecting the gear train.

Such a printer further includes a toner replenishing member for replenishing the developing device with toner. The developing device and the toner replenishing member are detachably attached to a main casing of the printer.

SUMMARY

In such a configuration, it is considered that the gear train and a toner filling port are both disposed at one side of the developing device and collectively covered by a side cover.

The above technique allows reduction in size of the developing unit, however, when the side cover is removed for toner filling, even a member unnecessary for the toner filling, such as a gear in the drive system covered by the side cover, is exposed to an outside and may be subject to damage.

In view of the foregoing, it is an object of the present invention to provide a cartridge capable of increasing reliability.

In order to attain the above and other objects, the present invention provides a cartridge that may include: a frame; an agitator; a coupling; a first transmission gear; a closing member; and a cover member. The frame may have a first wall and a second wall spaced apart from the first wall. The first wall may have a developer filling port. The agitator may be supported to the first wall and the second wall. The coupling may be provided at the first wall and configured to receive a drive force from an external drive source. The first transmission gear may be provided at the first wall and configured to transmit the drive force received by the coupling to the agitator. The closing member may be provided at the first wall and configured to close the developer filling port. The cover member may be provided at the first wall. The cover member may include: a first cover that may be configured to cover the first transmission gear; and a second cover that may be provided separately from the first cover and configured to cover the closing member.

According to another aspect, the present invention provides a cartridge that may include: a frame; an agitator; a coupling; a first transmission gear; a closing member; and a cover member. The frame may be configured to accommodate developing agent therein. The frame may have a developer filling port. The agitator may be configured to agitate the developing agent. The coupling may be configured to receive a drive force from an external drive source. The first transmission gear may be configured to transmit the drive force received by the coupling to the agitator. The closing member may be configured to close the developer filling port. The cover member may include: a first cover that may be configured to cover the first transmission gear; and a second cover that may be provided separately from the first cover and configured to cover the closing member.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings;

FIG. **1** is a central cross-sectional view of a developing cartridge as a cartridge according to one embodiment of the present invention;

FIG. **2** is a central cross-sectional view of a printer for which the developing cartridge in FIG. **1** is used;

FIG. **3** is a perspective view of the developing cartridge in FIG. **1** as viewed from a lower-left side thereof;

FIG. **4** is an exploded partial perspective view of the developing cartridge in FIG. **1** as viewed from a lower-left side thereof, from which a gear train and a gear cover has been removed;

FIG. **5** is an exploded partial perspective view of the developing cartridge in FIG. **1** as viewed from a lower-left side thereof, to which the gear train has been assembled and from which the gear cover has been removed;

FIG. **6** is an exploded perspective view of the developing cartridge in FIG. **1** as viewed from an upper-left side thereof, to which the gear train has been assembled and from which the gear cover has been removed;

FIG. **7** is an exploded partial perspective view of the developing cartridge in FIG. **1** as viewed from a lower-left side thereof, to which a first cover of the gear cover has been assembled and from which a second cover of the gear cover has been removed;

FIG. **8** is an explanatory view for illustrating the position of the gear train in FIG. **5**;

FIG. **9** is a perspective view of the second cover in FIG. **5** as viewed from an upper front side thereof;

FIG. **10**A is an explanatory view for illustrating an assembly of the gear cover to a left wall of a frame of the developing cartridge in FIG. **1**, in which the first cover has been assembled to the left wall of the frame and the second cover is in the course of being assembled to the left wall of the frame;

FIG. **10**B is an explanatory view for illustrating the assembly of the gear cover to the left wall of the frame, following FIG. **10**A, in which the first cover and the second cover have been assembled to the left wall of the frame;

FIG. **11** is a left side view of the developing cartridge in FIG. **1** that has been attached to a main casing of the printer;

FIG. **12**A is a left side view of the developing cartridge in FIG. **1** to which the first cover and the second cover have been assembled;

FIG. **12**B is a cross-sectional view of the developing cartridge taken along a line A-A in FIG. **12**A;

FIG. **13**A is a left side view of the developing cartridge in FIG. **1** in which the first cover has been assembled to the left wall but the second cover has been removed from the left wall;

FIG. **13**B is a cross-sectional view of the developing cartridge taken along a line B-B in FIG. **13**A;

FIG. **14**A is a left side view of a developing cartridge according to a modification to the embodiment; and

FIG. **14**B is a cross-sectional view of the developing cartridge taken along a line C-C in FIG. **14**A.

DETAILED DESCRIPTION

1. General Structure of Developing Cartridge

A developing cartridge as an example of a cartridge according to one embodiment of the present invention will be described with reference to FIG. **1**.

As illustrated in FIG. **1**, the developing cartridge **1** is configured to be attached to and detached from a drum cartridge **18** (described later). The developing cartridge **1** includes a developing roller **4**, a supply roller **5**, a layer thickness regulation blade **6**, a toner chamber **7**, and an agitator **8**.

In the following description, the terms "upward", "downward", "upper", "lower", "above", "below", "beneath", "right", "left", "front", "rear" and the like will be used assuming that the developing cartridge **1** is disposed in such an orientation that the developing roller **4** is disposed on a rear side. More specifically, in FIG. **1**, a left side and a right side are a rear side and a front side, respectively. Further, in FIG. **1**, a top side and a bottom side are a top side and a bottom side, respectively. Further, left and right sides of the developing cartridge **1** will be based on the perspective of a user facing the front of the developing cartridge **1**. Therefore, the near side of the developing cartridge **1** in FIG. **1** will be referred to as the "left side," and the far side thereof will be referred to as the "right side."

The developing roller **4** is disposed at a rear end portion of the developing cartridge **1**. The developing roller **4** includes a developing roller shaft **4**A, and a rubber roller **4**B.

The developing roller shaft **4**A has a substantially columnar shape extending in a left-right direction.

The rubber roller **4**B covers the entire developing roller shaft **4**A, excluding left and right end portions thereof.

The developing roller **4** is rotatably supported to a left wall **37** (described later) and a right wall **38** (described later) such that the left and right end portions of the developing roller shaft **4**A protrude outward in the left-right direction from the left and right walls **37** and **38**, respectively. The rubber roller **4**B of the developing roller **4** contacts a photosensitive drum **20** (described later) from a front side thereof.

The supply roller **5** is disposed diagonally below and frontward of the developing roller **4**. The supply roller **5** includes a supply roller shaft **5**A, and a sponge roller **5**B.

The supply roller shaft **5**A has a substantially columnar shape extending in the left-right direction.

The sponge roller **5**B covers the entire supply roller shaft **5**A, excluding left and right end portions thereof.

The supply roller **5** is rotatably supported to the left wall **37** (described later) and the right wall **38** (described later) such that the left and right end portions of the supply roller shaft **5**A protrude outward in the left-right direction from the left and right walls **37** and **38**, respectively. The sponge roller **5**B of the supply roller **5** contacts the developing roller **4** from a lower-front side thereof.

The layer thickness regulation blade **6** is disposed diagonally above and frontward of the developing roller **4**. The layer thickness regulation blade **6** contacts the developing roller **4** from a front side thereof.

The developing cartridge **1** defines an internal space serving as a toner chamber **7**. The toner chamber **7** is positioned frontward of the supply roller **5** and the layer thickness regulation blade **6**. The toner chamber **7** is adapted to accommodate toner therein. The agitator **8** is disposed in the toner chamber **7**.

The agitator **8** includes an agitator shaft **8**A, and an agitating blade **8**B.

The agitator shaft **8**A has a substantially columnar shape extending in the left-right direction.

The agitating blade **8**B is formed of a film having flexibility. The agitating blade **8**B extends outward in a radial direction of the agitator shaft **8**A from a left-right center portion of the agitator shaft **8**A, that is, a portion excluding left and right end portions of the agitator shaft **8**A.

The agitator **8** is rotatably supported to the left wall **37** (described later) and the right wall **38** (described later) such that the left and right end portions of the agitator shaft **8**A protrude outward in the left-right direction from the left and right walls **37** and **38**, respectively.

2. Overall Structure of Printer

As illustrated in FIG. **2**, a printer **11** to which the developing cartridge **1** is detachably mountable is an electrophotographic monochromatic printer. The printer **11** includes a main casing **12**, a process cartridge **13**, a scanner unit **14**, and a fixing unit **15**.

The main casing **12** has a substantially box-like shape. The main casing **12** has a front wall formed with an opening portion **16**. The main casing **12** includes a front cover **17**, a sheet cassette **29**, and a discharge tray **30**.

The opening portion **16** penetrates the front wall of the main casing **12** in a front-rear direction so as to allow the process cartridge **13** to pass therethrough.

The front cover **17** has a substantially plate-like shape. The front cover **17** is supported to the front wall of the main casing **12** and pivotally movable about its lower end portion. The front cover **17** opens and closes the opening portion **16**.

The sheet cassette **29** is disposed at a bottom portion of the main casing **12**. The sheet cassette **29** is adapted to accommodate sheets of paper P.

The discharge tray **30** is disposed at a top surface of the main casing **12**.

The process cartridge **13** is configured to be attached to and detached from the main casing **12**. The process cartridge **13** includes the developing cartridge **1** and the drum cartridge **18**.

The drum cartridge **18** includes the photosensitive drum **20**, a scorotron charger **21**, and a transfer roller **22**.

The photosensitive drum **20** is rotatably supported at a rear end portion of the process cartridge **13**. The photosensitive drum **20** has a substantially cylindrical shape elongated in the left-right direction.

The scorotron charger **21** is disposed rearward of the photosensitive drum **20** and spaced apart from the photosensitive drum **20**.

The transfer roller **22** is disposed below the photosensitive drum **20**. The transfer roller **22** contacts the photosensitive drum **20** from a lower side thereof.

The scanner unit **14** is disposed above the process cartridge **13**. As denoted by a dashed line of FIG. **2**, the scanner unit **14** is adapted to emit a laser beam based on image data toward the photosensitive drum **20**.

The fixing unit **15** is disposed rearward of the process cartridge **13**. The fixing unit **15** includes a heating roller **25**, and a pressure roller **26** in pressure contact with the heating roller **25** from a lower-rear side thereof.

When the printer **11** performs an image forming operation, the scorotron charger **21** applies a uniform charge to a surface of the photosensitive drum **20**. Thereafter, the scanner unit **14** exposes the surface of the photosensitive drum **20**. As a result, an electrostatic latent image based on image data is formed on the surface of the photosensitive drum **20**.

The agitator **8** agitates the toner accommodated in the toner chamber **7** and supplies the agitated toner to the supply roller

5. The supply roller **5** supplies the toner supplied from the agitator **8** to the developing roller **4**. At this time, the toner is positively tribo-charged between the developing roller **4** and the supply roller **5** to be carried on the developing roller **4**. The layer thickness regulation blade **6** regulates the toner carried on the developing roller **4** so that the developing roller **4** carries on its surface a thin layer of toner having a uniform thickness.

The toner carried on the developing roller **4** is supplied to the electrostatic latent image formed on the surface of the photosensitive drum **20**. As a result, a toner image is carried on the surface of the photosensitive drum **20**.

In the meantime, various rollers convey the sheets of paper P from the sheet cassette **29** at a prescribed timing, and supply the sheets P one at a time to a position between the photosensitive drum **20** and the transfer roller **22**. The toner image on the photosensitive drum **20** is transferred onto the sheet P upon passage to the position between the photosensitive drum **20** and the transfer roller **22**.

The sheet P onto which the toner image has been transferred passes between the heating roller **25** and the pressure roller **26**, at which time the heating roller **25** applies heat to the sheet P while the pressure roller **26** applies pressure to the sheet P, thermally fixing the toner image to the sheet P. Thereafter, the sheet P is discharged onto the discharge tray **30**.

3. Detailed Description of Developing Cartridge

The structure of the developing cartridge **1** according to the embodiment of the present invention will be described in greater detail with reference to FIGS. **3** through **13**B, wherein like parts and components are designated by the same reference numerals to avoid duplicating description.

As illustrated in FIGS. **3** and **4**, the developing cartridge **1** includes a frame **33**, and a drive unit **34**.

(1) Frame

The frame **33** is formed of a resin such as polystyrene (PS). The frame **33** has a substantially box-like shape elongated in the left-right direction. More specifically, the frame **33** includes the left wall **37** as an example of a first wall, the right wall **38** as an example of a second wall, a front wall **39**, a bottom wall **40**, and a top wall **41** (see FIG. **6**).

As illustrated in FIG. **4**, the left wall **37** is disposed at a left end portion of the frame **33**. The left wall **37** has a plate-like shape that is substantially rectangular in a side view and elongated in the front-rear direction. The left wall **37** includes a toner filling portion **43**, a cap **55** as an example of a closing member, a first screwed portion **47**, a co-fastening screwed portion **48**, a second screwed portion **49**, a protruding portion **50**, an idle gear support shaft **51**, and a hooking portion **52**.

The toner filling portion **43** is disposed at a front end portion of the left wall **37**. The toner filling portion **43** includes a toner filling port **44**, a toner filling cylindrical portion **45**, and a cap positioning portion **46**.

The toner filling port **44** has a substantially circular shape in a side view, and penetrates the left wall **37** in the left-right direction.

The toner filling cylindrical portion **45** has a substantially hollow cylindrical shape. The toner filling cylindrical portion **45** extends leftward from a left surface of the left wall **37** at a peripheral edge defining the toner filling port **44**. The toner filling cylindrical portion **45** has an inner diameter substantially the same as an inner diameter of the toner filling port **44**.

The cap positioning portion **46** is disposed diagonally below and rearward of the toner filling port **44**. The cap positioning portion **46** has a substantially columnar shape protruding leftward from the left surface of the left wall **37**.

The cap **55** includes a closing portion **56** and a reed-like piece **57**.

The closing portion **56** is configured to close the toner filling port **44**. The closing portion **56** has a plate-like shape that is substantially circular in a side view. The closing portion **56** includes a cap cylindrical portion **59**, a detection gear support shaft **60**, a guide portion **61**, and a pair of stoppers **62**.

The cap cylindrical portion **59** has a substantially cylindrical shape extending rightward from a right surface of the closing portion **56** at a peripheral portion thereof. The cap cylindrical portion **59** has an outer diameter slightly smaller than the inner diameter of the toner filling port **44**.

The detection gear support shaft **60** has a substantially columnar shape extending leftward from a left surface of the closing portion **56** at a center portion thereof.

The guide portion **61** protrudes leftward from a left surface of the closing portion **56** at a front half of a peripheral portion thereof. The guide portion **61** has a substantially semi-circular arc shape centering on the detection gear support shaft **60** in a left side view. The guide portion **61** has a left end surface that is gradually inclined leftward from its upstream end in a counterclockwise direction in a left side view toward its intermediate portion in the counterclockwise direction in a left side view, extends parallel to the closing portion **56** at the intermediate portion, and is then gradually inclined rightward toward its downstream end in the counterclockwise direction in a left side view.

In the left side surface of the guide portion **61**, the upstream end in the counterclockwise direction in a left side view will be referred to as an upstream inclined portion **61**A, the intermediate portion in the counterclockwise direction in a left side view will be referred to as an intermediate flat portion **61**B, and the downstream end in the counterclockwise direction in a left side view will be referred to as a downstream inclined portion **61**C.

The pair of stoppers **62** is disposed respectively at upstream and downstream ends of the guide portion **61** in the counterclockwise direction in a left side view so as to be spaced apart therefrom. That is, the pair of stoppers **62** is disposed rearward of the upstream inclined portion **61**A and the downstream inclined portion **61**C, respectively, so as to be spaced apart therefrom.

The reed-like piece **57** continues from a lower-rear end portion of an outer peripheral surface of the closing portion **56** and protrudes therefrom diagonally below and rearward. The reed-like piece **57** has a plate-like shape that is substantially circular in a side view. The reed-like piece **57** has a positioning hole **65**.

The positioning hole **65** has a substantially circular shape in a side view and penetrates, in the left-right direction, a substantial up-down and front-rear center of the reed-like piece **57**. The positioning hole **65** has an inner diameter slightly larger than an outer diameter of the cap positioning portion **46**.

The cap cylindrical portion **59** of the closing portion **56** is inserted along an inner peripheral surface of the toner filling cylindrical portion **45**, and the cap positioning portion **46** of the left wall **37** is inserted into the positioning hole **65** of the reed-like piece **57**, whereby the cap **55** is assembled to the left wall **37** to close the toner filling port **44**.

As illustrated in FIG. **6**, the first screwed portion **47** is disposed at an upper-rear end portion of the left wall **37**. The first screwed portion **47** has a substantially columnar shape protruding leftward from the left surface of the left wall **37**. The first screwed portion **47** has a first screw hole **47**A and includes a first engagement portion **47**B.

The first screw hole **47**A has a substantially circular shape in a side view and is recessed rightward from a left end face of the first screwed portion **47**.

The first engagement portion **47**B is disposed at a left end portion of the first screwed portion **47**. The first engagement portion **47**B has a substantially cylindrical shape extending leftward from a peripheral edge defining the first screw hole **47**A.

As illustrated in FIG. **4**, the co-fastening screwed portion **48** is disposed at a lower end portion of a substantial front-rear center of the left wall **37**. The co-fastening screwed portion **48** has a substantially columnar shape protruding leftward from the left surface of the left wall **37**. The co-fastening screwed portion **48** has a co-fastening screw hole **48**A and includes a co-fastening engagement portion **48**B.

The co-fastening screw hole **48**A has a substantially circular shape in a side view and is recessed rightward from a left end face of the co-fastening screwed portion **48**.

The co-fastening engagement portion **48**B is disposed at a left end portion of the co-fastening screwed portion **48**. The co-fastening engagement portion **48**B has a substantially cylindrical shape extending leftward from a peripheral portion defining the co-fastening screw hole **48**A.

The second screwed portion **49** is disposed at an upper-front end portion of the left wall **37**. The second screwed portion **49** has a substantially columnar shape protruding leftward from the left surface of the left wall **37**. The second screwed portion **49** has a second screw hole **49**A and includes a second engagement portion **49**B.

The second screw hole **49**A has a substantially circular shape in a side view and is recessed rightward from a left end face of the second screwed portion **49**.

The second engagement portion **49**B is disposed at a left end portion of the second screwed portion **49**. The second engagement portion **49**B has a substantially cylindrical shape extending leftward from a peripheral portion defining the second screw hole **49**A.

As illustrated in FIGS. **4** and **6**, the protruding portion **50** is disposed at a lower-rear end portion of the left wall **37**. The protruding portion **50** has a substantially columnar shape protruding leftward from the left surface of the left wall **37**.

As illustrated in FIG. **4**, the idle gear support shaft **51** is disposed at an upper end portion of the substantial front-rear center of the left wall **37**. The idle gear support shaft **51** has a substantially columnar shape protruding leftward from the left surface of the left wall **37**.

The hooking portion **52** is disposed on the left wall **37** at a position between the cap positioning portion **46** and the co-fastening screwed portion **48** in the front-rear direction. The hooking portion **52** has a plate-like shape that is substantially U-like shaped in a bottom view.

As illustrated in FIG. **3**, the right wall **38** is disposed at a right end portion of the frame **33**. Like the left wall **37**, the right wall **38** has a plate-like shape that is substantially rectangular in a side view and elongated in the front-rear direction.

The front wall **39** is bridged between a front end portion of the left wall **37** and a front end portion of the right wall **38**. The front wall **39** has a substantially plate-like shape extending in an up-down direction.

The bottom wall **40** is bridged between a lower end portion of the left wall **37** and a lower end portion of the right wall **38**. The bottom wall **40** extends rearward from a lower end portion of the front wall **39** while being curved. The bottom wall **40** has a substantially plate-like shape.

As illustrated in FIG. **6**, the top wall **41** is disposed on an upper end portion of the left wall **37**, an upper end portion of the right wall **38**, and an upper end portion of the front wall **39**. The top wall **41** has a substantially plate-like shape extending in the left-right direction. The top wall **41** has a peripheral portion fixed to the upper end portion of the left wall **37**, the upper end portion of the right wall **38**, and the upper end portion of the front wall **39** by welding or the like.

(2) Drive Unit

As illustrated in FIGS. **4** and **5**, the drive unit **34** includes a gear train **70** and a gear cover **71** as an example of a cover member.

(2-1) Gear Train

The gear train **70** is provided at the left wall **37**. The gear train **70** includes a developing coupling **74**, a developing gear **75** as an example of a developing roller drive gear, a supply gear **76** as an example of a supply roller drive gear, an idle gear **77** as an example of a second transmission gear, an agitator gear **78** as an example of an agitator drive gear, and a detection gear **79** as an example of a gear and as an example of a rotation body.

(2-1-1) Developing Coupling

The developing coupling **74** is rotatably supported at an upper-rear end portion of the left wall **37**. The developing coupling **74** has a substantially columnar shape extending in the left-right direction. The developing coupling **74** integrally includes a coupling gear portion **83** as an example of a first transmission gear and a coupling portion **84** as an example of a coupling.

The coupling gear portion **83** is disposed at a right end portion of the developing coupling **74**. The coupling gear portion **83** has a substantially disk-like shape having a thickness in the left-right direction. The coupling gear portion **83** has gear teeth formed on an entire outer peripheral surface thereof.

The coupling portion **84** has a substantially columnar shape protruding leftward from a left surface of the coupling gear portion **83**. The coupling portion **84** has an outer diameter smaller than an outer diameter of the coupling gear portion **83**. Further, the coupling portion **84** has a center axis aligned with a center axis of the coupling gear portion **83**. The coupling portion **84** includes a recessed portion **85** and a pair of projecting portions **86**.

The recessed portion **85** has a substantially circular shape in a side view. The recessed portion **85** is recessed rightward from a left end face of the coupling portion **84**.

The pair of projecting portions **86** each protrudes inward in a radial direction of the recessed portion **85** from an inner peripheral surface thereof in the radial direction. The pair of projecting portions **86** is disposed so as to face each other in the radial direction of the recessed portion **85**. The pair of projecting portions **86** each has a substantially rectangular columnar shape extending in the left-right direction.

(2-1-2) Developing Gear

The developing gear **75** is disposed diagonally below and rearward of the developing coupling **74**. The developing gear **75** has a substantially cylindrical shape extending in the left-right direction. The developing gear **75** has gear teeth formed on an entire outer peripheral surface thereof. The developing gear **75** is supported at a left end portion of the developing roller shaft **4**A so as not to be rotatable relative to the developing roller shaft **4**A. That is, the developing gear **75** is fixed to the developing roller shaft **4**A. The developing gear **75** is meshingly engaged with a lower-rear end portion of the coupling gear portion **83** of the developing coupling **74**.

(2-1-3) Supply Gear

The supply gear **76** is disposed below the developing coupling **74**. The supply gear **76** has a substantially columnar shape extending in the left-right direction. The supply gear **76** has gear teeth formed on an entire outer peripheral surface thereof. The supply gear **76** is supported at a left end portion of the supply roller shaft **5**A so as not to be rotatable relative

to the supply roller shaft **5**A. That is, the supply gear **76** is fixed to the supply roller shaft **5**A. The supply gear **76** is meshingly engaged with a lower end portion of the coupling gear portion **83** of the developing coupling **74**.

(2-1-4) Idle Gear

As illustrated in FIGS. **4** and **12**B, the idle gear **77** integrally includes a large-diameter idle gear **77**A, an intermediate-diameter idle gear **77**B, and a small-diameter idle gear **77**C.

The large-diameter idle gear **77**A has a substantially annular shape having a thickness in the left-right direction. The large-diameter idle gear **77**A has gear teeth formed on an entire outer peripheral surface thereof.

The intermediate-diameter idle gear **77**B protrudes rightward from a right surface of the large-diameter idle gear **77**A. The intermediate-diameter idle gear **77**B has a substantially hollow cylindrical shape with a closed right end. The intermediate-diameter idle gear **77**B has an outer diameter smaller than an outer diameter of the large-diameter idle gear **77**A. The intermediate-diameter idle gear **77**B has an inner diameter substantially the same as an inner diameter of the large-diameter idle gear **77**A.

The small-diameter idle gear **77**C has a substantially hollow cylindrical shape extending rightward from a right surface of the intermediate-diameter idle gear **77**B. The small-diameter idle gear **77**C has an outer diameter smaller than the outer diameter of the intermediate-diameter idle gear **77**B. The small-diameter idle gear **77**C has an inner diameter slightly larger than an outer diameter of the idle gear support shaft **51** protruding from the left wall **37**. The small-diameter idle gear **77**C has gear teeth formed on an entire outer peripheral surface thereof.

In the idle gear **77**, a center axis of the large-diameter idle gear **77**A, a center axis of the intermediate-diameter idle gear **77**B, and a center axis of the small-diameter idle gear **77**C are aligned with each other. The center axis of the idle gear **77** will be referred to a rotation axis CL.

The idle gear **77** is rotatably supported at the left wall **37** with the small-diameter idle gear **77**C inserted into the idle gear support shaft **51**. As a result, the idle gear **7** is disposed frontward of the developing coupling **74**. The large-diameter idle gear **77**A of the idle gear **77** is meshingly engaged with a front end portion of the coupling gear portion **83** of the developing coupling **74**.

(2-1-5) Agitator Gear

As illustrated in FIGS. **4** and **5**, the agitator gear **78** integrally includes a large-diameter agitator gear **78**A and a small-diameter agitator gear **78**B.

The large-diameter agitator gear **78**A has a substantially annular shape having a thickness in the left-right direction. The large-diameter agitator gear **78**A has gear teeth formed on an entire outer peripheral surface thereof.

The small-diameter agitator gear **78**B has a substantially hollow cylindrical shape protruding leftward from a left surface of the large-diameter agitator gear **78**A. The small-diameter agitator gear **78**B has an outer diameter smaller than an outer diameter of the large-diameter agitator gear **78**A. The small-diameter agitator gear **78**B has an inner diameter substantially the same as an inner diameter of the large-diameter agitator gear **78**A. The small-diameter agitator gear **78**B has gear teeth formed on an entire outer peripheral surface thereof.

The agitator gear **78** is supported at a left end portion of the agitator shaft **8**A so as not to be rotatable relative to the agitator shaft **8**A. That is, the agitator gear **78** is fixed to the agitator shaft **8**A. As a result, the agitator gear **78** is disposed diagonally below and frontward of the idle gear **77**. As illustrated in FIG. **8**, the large-diameter agitator gear **78**A of the agitator gear **78** is meshingly engaged with a lower-front end portion of the small-diameter idle gear **77**C of the idle gear **77**.

(2-1-6) Detection Gear

As illustrated in FIGS. **4** and **5**, the detection gear **79** includes a detection gear base plate **88**, a detection gear insertion portion **92**, a detection gear portion **89**, an abutting portion **90**, and a slide portion **91**.

The detection gear base plate **88** has a plate-like shape that is substantially circular in a side view.

The detection gear portion **89** has a substantially hollow cylindrical shape protruding rightward from a right surface of the detection gear base plate **88**. The detection gear portion **89** has gear teeth formed on a half portion of an outer peripheral surface thereof. That is, the detection gear portion **89** is a chipped gear (i.e. gear teeth are partially lacking).

The detection gear insertion portion **92** has a substantially hollow cylindrical shape extending in the left-right direction and having a center axis aligned with a center axis of the detection gear portion **89**. The detection gear insertion portion **92** penetrates the detection gear base plate **88** in the left-right direction. The detection gear insertion portion **92** has an inner diameter slightly larger than an outer diameter of the detection gear support shaft **60**.

The abutting portion **90** is disposed outward of the detection gear insertion portion **92** in a radial direction of the detection gear portion **89**. The abutting portion **90** protrudes leftward from a left surface of the detection gear base plate **88** and extends in a peripheral direction of the detection gear portion **89**. The abutting portion **90** has a substantially curved plate-like shape.

The slide portion **91** protrudes rightward from a right surface of the detection gear base plate **88** and extends in a radial direction of the detection gear base plate **88**. The slide portion **91** has a substantially plate-like shape.

The detection gear **79** is rotatably supported to the cap **55** with the detection gear support shaft **60** of the cap **55** inserted into the detection gear insertion portion **92**. That is, the detection gear **79** is supported at the left wall **37** through the cap **55**. As a result, the detection gear **79** is disposed frontward of the agitator gear **78**. The detection gear portion **89** of the detection gear **79** is adapted to meshingly engage the small-diameter agitator gear **78**B of the agitator gear **78**.

(2-2) Gear Cover

The gear cover **71** is assembled to the left wall **37** so as to cover the gear train **70** in its entirety. The gear cover **71** includes a first cover **95** and a second cover **96**.

(2-2-1) First Cover

As illustrated in FIGS. **5** and **6**, the first cover **95** integrally includes a first portion **98** and a second portion **99**.

The first portion **98** constitutes an upper portion of the first cover **95**. The first portion **98** integrally includes a first base plate **101**, and a first peripheral wall **102** protruding rightward from a peripheral edge of the first base plate **101**. That is, the first portion **98** has a substantially box-like shape whose right end is opened and whose left end is closed.

The first portion **98** includes a coupling cover portion **105**, a developing roller cover portion **106**, and a first fixed portion **107**.

The coupling cover portion **105** is provided at a substantial up-down and front-rear center of the first base plate **101**. The coupling cover portion **105** has a drive input opening **109** and includes a cylindrical portion **110** as an example of a receiving portion.

The drive input opening **109** has a substantially circular shape in a side view. The drive input opening **109** penetrates the first base plate **101** in the left-right direction.

The cylindrical portion **110** has a substantially hollow cylindrical shape and extends leftward from a left surface of the first base plate **101** at a peripheral edge defining the drive input opening **109**. The cylindrical portion **110** has an inner diameter substantially the same as a diameter of the drive input opening **109**. Further, as illustrated in FIG. **12**B, the cylindrical portion **110** has a left-right length substantially the same as a left-right length of the coupling portion **84** of the developing coupling **74**.

As illustrated in FIGS. **5** and **6**, a front end portion of the cylindrical portion **110** has a concave portion **112** extending in the left-right direction. Further, a peripheral surface of the cylindrical portion **110** has a first guide surface **111** at its front end.

The developing roller cover portion **106** is provided at a rear end portion of a substantial up-down center of the first base plate **101**. The developing roller cover portion **106** is disposed rearward of the coupling cover portion **105**. The developing roller cover portion **106** includes a collar portion **113**.

The collar portion **113** has a substantially hollow cylindrical shape with a closed left end and extends in the left-right direction. The collar portion **113** has an inner diameter slightly larger than an outer diameter of the developing roller shaft **4**A.

The first fixed portion **107** is provided at an upper-rear end portion of the first base plate **101**. The first fixed portion **107** is disposed above the developing roller cover portion **106**. The first fixed portion **107** is slightly recessed rightward from the developing roller cover portion **106**. The first fixed portion **107** has a first insertion hole **114**.

The first insertion hole **114** has a substantially circular shape in a side view. The first insertion hole **114** penetrates the first base plate **101** in the left-right direction. The first insertion hole **114** has an inner diameter slightly larger than an outer diameter of the first engagement portion **47**B.

The second portion **99** constitutes a lower portion of the first cover **95**. The second portion **99** is disposed below the first portion **98** with a stepped portion interposed therebetween. The second portion **99** integrally includes a second base plate **117** and a second peripheral wall **118** protruding rightward from a peripheral edge of the second base plate **117**. That is, the second portion **99** has a substantially box-like shape whose right end is opened and whose left end is closed.

The second portion **99** includes a supply roller cover portion **122**, an engaging portion **125**, a cutout portion **121**, and a first co-fastening portion **119**.

The supply roller cover portion **122** is provided at a substantial front-rear center of the second base plate **117**. The supply roller cover portion **122** is disposed below the coupling cover portion **105**.

The engaging portion **125** is provided at a rear end portion of the second base plate **117**. The engaging portion **125** is disposed below the developing roller cover portion **106** and rearward of the supply roller cover portion **122**. The engaging portion **125** has a substantially bottomed frame-like shape with a closed right end. As illustrated in FIG. **11**, the engaging portion **125** has an engaging insertion hole **126**.

The engaging insertion hole **126** has a substantially circular in a side cross-sectional view. The engaging insertion hole **126** penetrates a right end portion of the engaging portion **125** in the left-right direction.

Further, as illustrated in FIG. **5**, the engaging portion **125** includes a protruding wall **127**.

The protruding wall **127** protrudes rightward from a lower-right end portion and a rear-right end portion of the engaging portion **125**. The protruding wall **127** has a plate shape that is substantially L-like shaped in a side view.

As illustrated in FIGS. **5** and **6**, the cutout portion **121** is formed by cutting a substantial front-rear center portion of a lower portion of the second peripheral wall **118** at a position rightward of the supply roller cover portion **122**. In other words, the cutout portion **121** is defined as a space rightward of the supply roller cover portion **122** and frontward of the engaging portion **125**.

The first co-fastening portion **119** is disposed frontward of the supply roller cover portion **122** and protrudes frontward from a front-right end portion of the second peripheral wall **118**. The first co-fastening portion **119** is recessed rightward from the coupling cover portion **105**. The first co-fastening portion **119** has a substantially box-like shape whose right end is opened and whose left end is closed. The first co-fastening portion **119** has a first co-fastening insertion hole **128**.

The first co-fastening insertion hole **128** has a substantially circular shape in a side view. The first co-fastening insertion hole **128** penetrates, in the left-right direction, an up-down and front-rear center of the left end of the first co-fastening portion **119**. The first co-fastening insertion hole **128** has an inner diameter larger than an outer diameter of the co-fastening engagement portion **48**B of the co-fastening screwed portion **48**.

(2-2-2) Second Cover

The second cover **96** is provided as a separate member from the first cover **95**, and thus separable from the first cover **95**. The second cover **96** integrally includes a third portion **131**, a fourth portion **132**, and a fifth portion **133**.

The third portion **131** constitutes an upper-rear portion of the second cover **96**. The third portion **131** integrally includes a third base plate **136**, and a third peripheral wall **137** protruding rightward from a peripheral edge of the third base plate **136**. That is, the third portion **131** has a substantially box-like shape whose right end is opened and whose left end is closed.

As illustrated in FIGS. **9** and **12**B, the third portion **131** includes an idle gear regulation portion **140** as an example of a support portion.

The idle gear regulation portion **140** has a substantially cylindrical shape protruding rightward from a right surface of the third base plate **136** at its substantial center. The idle gear regulation portion **140** has an outer diameter slightly smaller than the inner diameters of the large-diameter idle gear **77**A and the intermediate-diameter idle gear **77**B of the idle gear **77**, respectively.

A rear edge of the third base plate **136** of the third portion **131** is recessed frontward in a curved manner and is defined as a second guide surface **139**.

As illustrated in FIGS. **5** and **6**, the fourth portion **132** constitutes a lower-rear portion of the second cover **96**. The fourth portion **132** continues from a lower-right edge of the third peripheral wall **137** of the third portion **131** and protrudes downward therefrom. The fourth portion **132** includes a fourth base plate **142**, and a fourth peripheral wall **143** protruding rightward from a lower edge of the fourth base plate **142**. That is, the fourth portion **132** has a plate-like shape that is substantially L-like shaped in a front cross-sectional view.

The fourth portion **132** includes a second co-fastening portion **145** and an engaging claw **146**.

The second co-fastening portion **145** is provided at a rear portion of the fourth base plate **142**. The second co-fastening portion **145** has a second co-fastening insertion hole **147**.

The second co-fastening insertion hole **147** has a substantially circular shape in a side view. The second co-fastening insertion hole **147** penetrates the fourth base plate **142** in the left-right direction.

As illustrated in FIG. **9**, the engaging claw **146** protrudes rightward from a right end portion of the fourth peripheral wall **143** at its substantial front-rear center and is bent upward at a right end portion thereof. That is, the engaging claw **146** has a substantially hook-like shape.

As illustrated in FIGS. **5** and **6**, the fifth portion **133** constitutes a front portion of the second cover **96**. The fifth portion **133** continues from front edges of the respective third and fourth portions **131** and **132**, and protrudes leftward therefrom. The fifth portion **133** includes a detection gear cover portion **150** and a second fixed portion **151**.

The detection gear cover portion **150** continues from the front edges of the respective third and fourth portions **131** and **132**, and protrudes leftward therefrom. The detection gear cover portion **150** has a substantially cylindrical shape with a closed left end. That is, the left end of the detection gear cover portion **150** is positioned leftward of the third and fourth portions **131** and **132**. The detection gear cover portion **150** has an abutting portion opening **154** and includes a detection gear regulation portion **155** (see FIG. **9**).

As illustrated in FIG. **3**, the abutting portion opening **154** has a substantially C-like shape in a side view with a closed lower end so as to allow the abutting portion **90** of the detection gear **79** to protrude therethrough. The abutting portion opening **154** penetrates a left wall of the detection gear cover portion **150** in the left-right direction.

As illustrated in FIGS. **9** and **12**B, the detection gear regulation portion **155** has a substantially columnar shape protruding rightward from a right surface of the left wall of the detection gear cover portion **150** at a center thereof. The detection gear regulation portion **155** has an outer diameter slightly smaller than an inner diameter of the detection gear insertion portion **92**.

As illustrated in FIGS. **5** and **6**, the second fixed portion **151** protrudes frontward from an upper-front end portion of the detection gear cover portion **150** at its right end. The second fixed portion **151** has a substantially box-like shape whose right end is opened and whose left end is closed. A left wall of the second fixed portion **151** is positioned rightward of the third base plate **136** and substantially flush with the fourth base plate **142**. The second fixed portion **151** has a second insertion hole **157**.

The second insertion hole **157** has a substantially circular shape in a side view. The second insertion hole **157** penetrates the left wall of the second fixed portion **151** in the left-right direction. The second insertion hole **157** has an inner surface slightly larger than an outer diameter of the second engagement portion **49**B.

4. Assembly and Removal of Gear Cover Relative to Frame

The gear cover **71** having the above-described configuration is assembled to the frame **33** by a user.

In order to assemble the gear cover **71** to the frame **33**, first, the first cover **95** of the gear cover **71** is assembled, from the left, to the left wall **37** to which the gear train **70** has been assembled, as illustrated in FIG. **5**. More specifically, the first cover **95** is assembled, from the left, to the left wall **37** with the collar portion **113** receiving the developing roller shaft **4**A and with the cylindrical portion **110** receiving the coupling portion **84**.

Then, the first insertion hole **114** of the first cover **95** receives the first engagement portion **47**B of the left wall **37**, the first co-fastening insertion hole **128** of the first cover **95** receives the co-fastening engagement portion **48**B of the left wall **37** and, as illustrated in FIG. **11**, the engaging insertion hole **126** of the engaging portion **125** of the first cover **95** receives the protruding portion **50** of the left wall **37**.

As a result, as illustrated in FIG. **7**, a left end face of the supply gear **76** and a right surface of the supply roller cover portion **122** face each other in the left-right direction with a space therebetween.

Next, a first screw **67** as an example of a screw member is screwed into the first screw hole **47**A through the first insertion hole **114**.

Thus, the first cover **95** is assembled to the left wall **37** so as to cover the developing coupling **74**, the developing gear **75**, and the supply gear **76**.

Incidentally, a lower end portion of the supply gear **76** is exposed to outside through the cutout portion **121** of the supply roller cover portion **122**. Further, as described above, the coupling cover portion **105** covers a part of the idle gear **77**.

Subsequently, the second cover **96** is assembled, from the left, to the left wall **37**.

As illustrated in FIGS. **10**A and **10**B, in this assembly of the second cover **96** to the left wall **37**, the second guide surface **139** of the second cover **96** is guided by the first guide surface **111** of the first cover **95** while slidingly contacting the first guide surface **111**. Then, the second insertion hole **157** of the second cover **96** receives the second engagement portion **49**B of the left wall **37**, and the second co-fastening insertion hole **147** of the second cover **96** receives the co-fastening engagement portion **48**B of the left wall **37**. Further, the engaging claw **146** is engaged with the hooking portion **52**. In this state, as illustrated in FIG. **12**B, the idle gear regulation portion **140** of the second cover **96** is inserted into the large-diameter idle gear **77**A of the idle gear **77**, and the detection gear regulation portion **155** of the second cover **96** is inserted into the detection gear insertion portion **92** of the detection gear **79**.

As a result, the third base plate **136** covers the idle gear **77** and the agitator gear **78**, and the detection gear cover portion **150** covers the detection gear **79**. Further, the idle gear **77** and the detection gear **79** are each rotatably supported to the left wall **37** without displacement of the rotation axis (center axis) thereof.

Then, as illustrated in FIGS. **5** and **6**, a second screw **68** as an example of a screw member is screwed into the second screw hole **49**A through the second insertion hole **157**.

Further, as illustrated in FIG. **7**, a co-fastening screw **69** as an example of a screw member is screwed into the co-fastening screw hole **48**A through the first co-fastening insertion hole **128** and the second co-fastening insertion hole **147**. That is, the first cover **95** and the second cover **96** are co-fastened by the common screw member. The second co-fastening portion **145** of the second cover **96** is disposed leftward of the first co-fastening portion **119** of the first cover **95**.

Thus, the second cover **96** is assembled to the left wall **37** so as to cover the idle gear **77**, the agitator gear **78**, the detection gear **79**, and the cap **55**.

In this manner, assembly of the developing cartridge **1** is completed.

To remove the gear cover **71** from the left wall **37**, the operation to assemble the gear cover **71** to the left wall **37** described above is performed in reverse.

More specifically, the second screw **68** is unscrewed from the second screw hole **49**A, and the co-fastening screw **69** is unscrewed from the co-fastening screw hole **48**A. This allows the second cover **96** to be separated from the first cover **95**, and only the second cover **96** is removed from the left wall **37**.

Then, the detection gear **79** is removed from the gear train **70**, and this allows the cap **55** to be removed from the toner filling port **44**. When the cap **55** is removed from the toner filing port **44**, the toner filling port **44** is exposed to an outside. Thus, toner can be supplied to the toner chamber **7** through the toner filing port **44**.

Further, as illustrated in FIG. **13**A, the front end portion of the cylindrical portion **110** is overlapped with a rear end portion of the idle gear **77** in a left side view. In other words, the first cover **95** covers a part of the idle gear **77**. This prevents the idle gear **77** from coming off from the left wall **37**.

To remove the idle gear **77** from the left wall **37**, the idle gear **77** is inclined frontward relative to the idle gear support shaft **51**, as illustrated in FIG. **13**B. Then, the overlap between the idle gear **77** and the first cover **95** is released as viewed in the left-right direction. That is, as viewed in the left-right direction, the idle gear **77** and the first cover **95** are no longer overlapped with each other, thus releasing the covering of the idle gear **77** by the first cover **95** is released.

This allows only the idle gear **77** to be removed from the left wall **37**.

Further, the removal of the idle gear **77** from the left wall **37** allows removal of the agitator gear **78** disposed inward in the left-right direction (i.e. rightward) of the idle gear **77**.

As a result, the idle gear **77** and the agitator gear **78** can be removed from the left wall **37** with the first cover **95** still assembled to the left wall **37** and can then be subjected to maintenance.

Subsequently, the first screw **67** is unscrewed from the first screw hole **47**A, and the first cover **95** is removed from the left wall **37**. Thus, the gear cover **71** is removed from the left wall **37**.

5. Attachment of Developing Cartridge to Main Casing and New Cartridge Detection Operation

In order to attach the developing cartridge **1** to the main casing **12**, the developing cartridge **1** is first attached to the drum cartridge **18** to constitute the process cartridge **13**.

As illustrated in FIG. **11**, the drum cartridge **18** has left and right side walls at which collar receiving grooves **160** are formed respectively. The collar receiving groove **160** at the left side wall of the drum cartridge **18** receives the collar portion **113** of the gear cover **71** and fixes the collar portion **113** in position when the developing cartridge **1** is attached to the drum cartridge **18**.

The collar portion **113** rotatably receives the left end portion of the developing roller shaft **4**A. Thus, by attaching the developing cartridge **1** to the drum cartridge **18** with the collar portion **113** as a reference, the developing roller **4** is precisely fixed in position relative to the photosensitive drum **20**.

Subsequently, the drum cartridge **18** to which the developing cartridge **1** has been attached, that is, the process cartridge **13** is attached to the main casing **12**.

To attach the process cartridge **13** to the main casing **12**, as illustrated in FIG. **2**, the front cover **17** is opened, and the process cartridge **13** is inserted, from the front, into the main casing **12** through the opening portion **16** and attached to the main casing **12**.

In this manner, the attachment of the process cartridge **13** to the main casing **12** is completed.

As illustrated in FIG. **11**, when the developing cartridge **1** is a new cartridge, the abutting portion **90** of the detection gear **79** is positioned in the abutting portion opening **154** of the second cover **96** at a front end portion thereof. As illustrated in FIG. **3**, a left edge of the abutting portion **90** is substantially flush with a left end face of the detection gear cover portion **150**. Further, as illustrated in FIG. **8**, the detection gear portion **89** of the detection gear **79** is meshingly engaged with a front end portion of the small-diameter agitator gear **78**B of the agitator gear **78** at a downstream end portion thereof in the counterclockwise direction in a left side view. Further, the slide portion **91** of the detection gear **79** is positioned upstream of the guide portion **61** of the cap **55** in the counterclockwise direction in a left side view. That is, the guide portion **61** of the cap **55** is positioned upstream of the upstream inclined portion **61**A in the counterclockwise direction in a left side view.

When the printer **11** starts its warm-up operation, a drive input unit (not illustrated) of the main casing **12** inputs a drive force to the developing coupling **74**.

Upon receiving the drive force, the developing coupling **74** transmits the drive force to the idle gear **77** and the agitator gear **78** through the coupling gear portion **83**. Upon receiving the drive force, the idle gear **77** and the agitator gear **78** transmit the drive force to the detection gear portion **89** of the detection gear **79**. Then, the detection gear **79** rotates in the counterclockwise direction in a left side view, as illustrated in FIG. **11**.

At this time, the slide portion **91** of the detection gear **79** is slidingly moved along the left end surface of the guide portion **61** in the counterclockwise direction in a left side view. Accordingly, the slide portion **91** is gradually moved leftward along the upstream inclined portion **61**A of the guide portion **61**, and the abutting portion **90** of the detection gear **79** protrudes leftward further than the left end face of the detection gear cover portion **150** through the abutting portion opening **154**.

Then, in a state where the abutting portion **90** protrudes leftward further than the abutting portion opening **154**, the detection gear **79** rotates in the counterclockwise direction in a left side view while the slide portion **91** is moved along the intermediate flat portion **61**B. Then, the abutting portion **90** abuts against an actuator **163** of the main casing **12**. As a result, the actuator **163** detects a condition of the developing cartridge **1**.

The slide portion **91** urges, with an urging force from an urging spring (not illustrated), the detection gear **79** rightward along a downstream end of the guide portion **61** in the counterclockwise direction in a left side view, that is, along the downstream inclined portion **61**C.

Then, the slide portion **91** abuts against one of the pair of stoppers **62** (i.e. upper stopper **62**) from a front side thereof to stop the rotation of the detection gear **79**. Further, the meshing engagement of the detection gear portion **89** of the detection gear **79** with the small-diameter agitator gear **78**B of the agitator gear **78** is released.

As a result, the left edge of the abutting portion **90** becomes substantially flush with the left end face of the detection gear cover portion **150** once again.

When the developing cartridge **1** is a used cartridge, the abutting portion **90** of the detection gear **79** is positioned in the abutting portion opening **154** of the second cover **96** at a rear end portion thereof and the left edge of the abutting portion **90** is substantially flush with the left end face of the detection gear cover portion **150**. Further, the detection gear portion **89** of the detection gear **79** is not engaged with the small-diameter agitator gear **78**B of the agitator gear **78**. Further, the slide portion **91** of the detection gear **79** is positioned downstream of the guide portion **61** of the cap **55** in the counterclockwise direction in a left side view. Thus, when the printer **11** starts its warm-up operation, the detection gear **79** does not start rotating and maintains its posture.

As described above, the posture of the detection gear **79** can be changed depending on whether the developing cartridge **1** is a new cartridge or not.

6. Operations and Effects

(1) According to the developing cartridge **1** described above, as illustrated in FIGS. **4** and **5**, the first cover **95** covers the coupling gear portion **83** of the developing coupling **74**, the second cover **96** covers the cap **55**, and the first and second covers **95** and **96** are configured to be separable from each other.

Thus, the second cover **96** can be separated from the first cover **95** and then removed from the left wall **37** in a state where the first cover **95** has been assembled to the left wall **37**. Accordingly, the toner filling port **44** can be exposed to an outside for toner supply with the coupling gear portion **83** of the developing coupling **74** being covered with the first cover **95**.

As a result, removal of only the second cover **96** from the left wall **37** allows supply of the toner. At the same time, the first cover **95** prevents damage to the coupling gear **83** of the developing coupling **74** to which the drive force is inputted.

This allows the toner to be supplied through the toner filling port **44** while protecting the coupling gear portion **83** of the developing coupling **74**, thereby increasing reliability of the developing cartridge **1**.

(2) Further, according to the developing cartridge **1**, as illustrated in FIG. **6**, the first cover **95** covers the coupling gear portion **83**, and the coupling portion **84** integrally formed with the coupling gear portion **83**. The coupling portion **84** is positioned on the most upstream side among the gears of the gear train **70** for transmission of the drive force, and is the most important functional component for image formation among the gears of the gear train **70**. Thus, it is important to prevent the coupling portion **84** from being damaged.

Thus, the coupling portion **84** is covered and protected by the first cover **95**. This allows the drive force from the drive input unit (not illustrated) of the main casing **12** to be inputted reliably to the coupling portion **84**, thereby allowing the drive force inputted to the coupling portion **84** to be transmitted reliably to the agitator **8** by the coupling gear portion **83**.

(3) Further, according to the developing cartridge **1**, as illustrated in FIG. **6**, the second cover **96** covers the agitator gear **78**.

Thus, the second cover **96** can be separated from the first cover **95** and then removed from the left wall **37** to allow a covered state of the agitator gear **78** to be released.

This facilitates maintenance of the agitator gear **78** with the coupling gear portion **83** of the developing coupling **74** being covered by the first cover **95**.

(4) Further, according to the developing cartridge **1**, as illustrated in FIGS. **13**A and **13**B, even when the second cover **96** is removed from the left wall **37** for supply of the toner through the toner filling port **44**, the covered state of the idle gear **77** by the first cover **95** is not released unless the idle gear **77** is inclined in a direction intersecting a direction in which the rotation axis CL extends, that is, frontward.

Thus, the toner can be supplied while preventing the idle gear **77** from coming off from the left wall **37**.

(5) Further, according to the developing cartridge **1**, as illustrated in FIGS. **12**A and **12**B, the frontward inclination of the idle gear **77** is regulated by the idle gear regulation portion **140**, thereby preventing the idle gear **77** from coming off from the left wall **37**.

This allows the drive force inputted from the drive force input unit (not illustrated) of the main casing **12** to the coupling gear portion **83** to be transmitted reliably to the agitator gear **78** through the idle gear **77**.

(6) Further, according to the developing cartridge **1**, as illustrated in FIGS. **13**A and **13**B, the first cover **95** covers a part of the idle gear **77** by contacting the idle gear **77** from the left.

Thus, even in a state where the second cover **96** is removed from the left wall **37** and only the first cover **95** is assembled to the left wall **37**, the idle gear **77** can be prevented from coming off from the left wall **37**.

(7) Further, according to the developing cartridge **1**, as illustrated in FIGS. **12**A and **12**B, the idle gear **77** is sandwiched between the agitator gear **78** and the first cover **95** so as to contact the agitator gear **78** and the first cover **95**.

Thus, even in a state where the second cover **96** is removed, the idle gear **77** is prevented from coming off from the left wall **37** by the first cover **95**, and the agitator gear **78** is prevented from coming off from the left wall **37** by the idle gear **77**.

(8) Further, according to the developing cartridge **1**, as illustrated in FIG. **5**, the developing gear **75** is covered with the first cover **95**.

Thus, even in a state where the second cover **96** is separated from the first cover **95** and then removed from the left wall **37** for supply of the toner, the developing gear **75** can be covered by the first cover **95**.

(9) Further, according to the developing cartridge **1**, the first cover **95** is fixed in position relative to the left wall **37** with the developing roller shaft **4**A as a reference shaft. Further, as illustrated in FIG. **11**, the collar receiving groove **160** formed in the drum cartridge **18** guides the collar portion **113** of the first cover **95** when attaching the developing cartridge **1** to the drum cartridge **18**. Hence, the developing cartridge **1** can be fixed in position relative to the drum cartridge **18** with the developing roller shaft **4**A as a reference shaft.

This can bring the developing roller **4** into contact with the photosensitive drum **20** precisely.

(10) Further, according to the developing cartridge **1**, as illustrated in FIG. **4**, the detection gear **79** is positioned so as to overlap with the cap **55** as viewed in the left-right direction. Thus, the members constituting the developing cartridge **1** can be gathered into one place.

This allows reduction in size of the developing cartridge **1**.

(11) Further, according to the developing cartridge **1**, as illustrated in FIG. **11**, the detection gear **79** configured to change its posture depending on whether the developing cartridge **1** is a new cartridge or a used cartridge is positioned so as to overlap with the cap **55** as viewed in the left-right direction. Thus, the members constituting the developing cartridge **1** can be gathered into one place.

This allows determination of whether the developing cartridge **1** is a new cartridge or a used cartridge while achieving reduction in size of the developing cartridge **1**.

(12) Further, according to the developing cartridge **1**, as illustrated in FIG. **5**, the first cover **95** and the second cover **96** can be fixed together to the left wall **37** by screwing the common co-fastening screw **69** into the co-fastening screwed portion **48** of the left wall **37**, thereby improving assembly precision and reducing the number of components.

(13) Further, according to the developing cartridge **1**, as illustrated in FIG. **5**, even when the first cover **95** and the second cover **96** are fixed together in an overlapped manner to the left wall **37** by means of the common co-fastening screw **69**, the second cover **96** can be removed from the left wall **37** by unscrewing the co-fastening screw **69** with the first cover **95** being assembled to the left wall **37**.

Thus, with the first cover **95** being assembled to the left wall **37**, the second cover **96** can be removed from the left wall **37** for supply of the toner through the toner filling port **44**.

As a result, the toner can be supplied while reliably covering the coupling gear portion **83** of the developing coupling **74** with the first cover **95**.

(14) Further, according to the developing cartridge **1**, as illustrated in FIGS. **10**A and **10**B, the second cover **96** can be assembled to the left wall **37** with the second guide surface **139** of the second cover **96** fixed in position relative to the first guide surface **111** of the cylindrical portion **110** and guided by the first guide surface **111** of the cylindrical portion **110**.

Thus, the second cover **96** can be assembled to the left wall **37** while being fixed in position precisely relative to the first cover **95**.

(15) Further, according to the developing cartridge **1**, as illustrated in FIG. **5**, the supply gear **76** is covered with the first cover **95**.

Thus, even when the second cover **96** is separated from the first cover **95** and then removed from the left wall **37** for supply of the toner, the supply gear **76** can be covered with the first cover **95**.

In addition, as illustrated in FIG. **3**, the first cover **95** has the cutout portion **121** so that the lower end portion of the supply gear **76** is exposed to an outside.

This allows reduction in size of the first cover **95**, which in turn can achieve further reduction in size of the developing cartridge **1**.

7. Modifications

Various modifications are conceivable. In the following description, only parts differing from those of the embodiment will be described in detail.

For example, as illustrated in FIG. **14**, the protruding portion **50** of the left wall **37** that has been inserted through the engaging insertion hole **126** formed in the engaging portion **125** of the first cover **95** may be force-fitted (such as caulking accompanied by plastic deformation) at its left end portion.

According to such a modification to the developing cartridge **1**, the force-fitting of the protruding portion **50** of the left wall **37** relative to the first cover **95** can prevent the first cover **95** from unintentionally coming off from the frame **33** at the time of removal of the second cover **96**.

As a result, the first cover **95** and the second cover **96** can be efficiently assembled to and removed from the left wall **37**.

In place of the force-fitting, the protruding portion **50** may be adhered to the engaging portion **125** by an adhesive agent, etc., to assemble the first cover **95** to the frame **33**.

Although the process cartridge **13** according to the above embodiment is a separate type in which the developing cartridge **1** and the drum cartridge **18** are separable from each other, the process cartridge **13** may be configured as an integrated type that integrally includes the developing cartridge **1** and the drum cartridge **18**.

Further, the cartridge according to the present invention may be configured as a toner cartridge in which the developing roller **4** is not provided but the agitator **8** is provided.

In place of the cap **55** as an example of a closing member, a sealing member or a shutter may be available.

In place of the detection gear **79**, a rotation body such as a drive transmission roller around which a belt is stretched and that is rotated by friction may be available.

While the present invention has been described in detail with reference to the embodiment thereof, it would be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the present invention.

What is claimed is:

1. A cartridge comprising:

a frame having a first wall and a second wall spaced apart from the first wall, the first wall having a developer filling port;

an agitator supported to the first wall and the second wall, the agitator having an agitator shaft;

a coupling provided at the first wall and configured to receive a drive force from an external drive source;

a first transmission gear provided at the first wall and configured to transmit the drive force received by the coupling to the agitator;

a closing member provided at the first wall and configured to close the developer filling port;

a cover member provided at the first wall, the cover member comprising:

a first cover configured to cover the first transmission gear; and

a second cover provided separately from the first cover, the second cover being configured to cover the closing member; and

an agitator drive gear fixed to the agitator shaft and configured to transmit the drive force from the first transmission gear to the agitator, the second cover being configured to cover the agitator drive gear.

2. The cartridge as claimed in claim **1**, wherein the first transmission gear is integral with the coupling.

3. The cartridge as claimed in claim **1**, further comprising a second transmission gear provided at the first wall and having a rotation axis extending in an axial direction, the second transmission gear being configured to transmit the drive force from the first transmission gear to the agitator drive gear, the second transmission gear having a first portion covered with the first cover and a second portion covered with the second cover,

wherein the second transmission gear is configured to be inclined in a direction angled with respect to the axial direction to expose the first portion of the second transmission gear to an outside of the first cover.

4. The cartridge as claimed in claim **3**, wherein the second cover includes a support portion configured to regulate the second transmission gear from being inclined in the direction angled with respect to the axial direction.

5. The cartridge as claimed in claim **3**, wherein the first cover is disposed opposite to the second wall with respect to the first wall in the axial direction; and

wherein the second transmission gear is disposed between the first cover and the first wall in the axial direction at a position adjacent to the first cover and contactable with the first cover.

6. The cartridge as claimed in claim **4**, wherein the first cover is disposed opposite to the second wall with respect to the first wall in the axial direction;

wherein the second transmission gear is configured to be meshingly engaged with the agitator drive gear; and

wherein the second transmission gear is disposed between the first cover and the agitator drive gear in the axial direction at a position adjacent to the agitator drive gear and contactable with the agitator drive gear.

7. The cartridge as claimed in claim **1**, further comprising:

a developing roller supported to the first wall and the second wall, the developing roller having a developing roller shaft; and

a developing roller drive gear fixed to the developing roller shaft and configured to transmit the drive force received by the coupling to the developing roller, the first cover being configured to cover the developing roller drive gear.

8. The cartridge as claimed in claim 7, wherein the first cover is fixed in position relative to the first wall by the developing roller shaft serving as a reference shaft.

9. The cartridge as claimed in claim 1, wherein the agitator shaft extends in a predetermined direction, the cartridge further comprising:

a gear aligned with the closing member in the predetermined direction.

10. The cartridge as claimed in claim 1, wherein the agitator shaft extends in a predetermined direction, the cartridge further comprising:

a rotation body aligned with the closing member in the predetermined direction, the rotation body being configured to have a first posture indicative of a new cartridge and a second posture indicative of a used cartridge, the second posture being different from the first posture.

11. The cartridge as claimed in claim 1, wherein the first cover is assembled to the first wall by force-fitting to regulate detachment of the first cover from the frame; and

wherein the second cover is assembled to the first wall by a screw member.

12. The cartridge as claimed in claim 1, wherein the first cover and the second cover are assembled to the first wall by a common screw member.

13. The cartridge as claimed in claim 12, wherein the agitator shaft extends in a predetermined direction; and

wherein, as viewed in the predetermined direction, the second cover is disposed opposite to the first wall with respect to the first wall at a position where the first cover, the second cover and the common screw member overlap one another.

14. The cartridge as claimed in claim 1, wherein the agitator shaft extends in a predetermined direction;

wherein the first cover includes a receiving portion formed in an annular shape extending in the predetermined direction, the receiving portion being configured to receive the coupling; and

wherein the receiving portion is configured to guide the second cover so that the second cover moves in the predetermined direction to be assembled to the first wall.

15. The cartridge as claimed in claim 1, further comprising:

a supply roller supported to the first wall and the second wall, the supply roller having a supply roller shaft; and

a supply roller drive gear fixed to the supply roller shaft and configured to transmit the drive force received by the coupling to the supply roller,

wherein the first cover is configured to cover the supply roller drive gear; and

wherein the agitator shaft extends in a predetermined direction, the supply roller drive gear having a portion exposed to an outside through the first cover as viewed in a direction perpendicular to the predetermined direction.

16. A cartridge comprising:

a frame configured to accommodate developing agent therein, the frame having a developer filling port;

an agitator configured to agitate the developing agent, the agitator having an agitator shaft;

a coupling configured to receive a drive force from an external drive source;

a first transmission gear configured to transmit the drive force received by the coupling to the agitator;

a closing member configured to close the developer filling port;

a cover member comprising:

a first cover configured to cover the first transmission gear; and

a second cover provided separately from the first cover, the second cover being configured to cover the closing member; and

an agitator drive gear fixed to the agitator shaft and configured to transmit the drive force from the first transmission gear to the agitator, the second cover being configured to cover the agitator drive gear.

17. The cartridge as claimed in claim 16, wherein the first transmission gear is integral with the coupling.

18. The cartridge as claimed in claim 16, wherein the first cover and the second cover are assembled to the frame by a common screw member.

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